ENGIN. LIBRARY
TA
1
E42

The Engineer

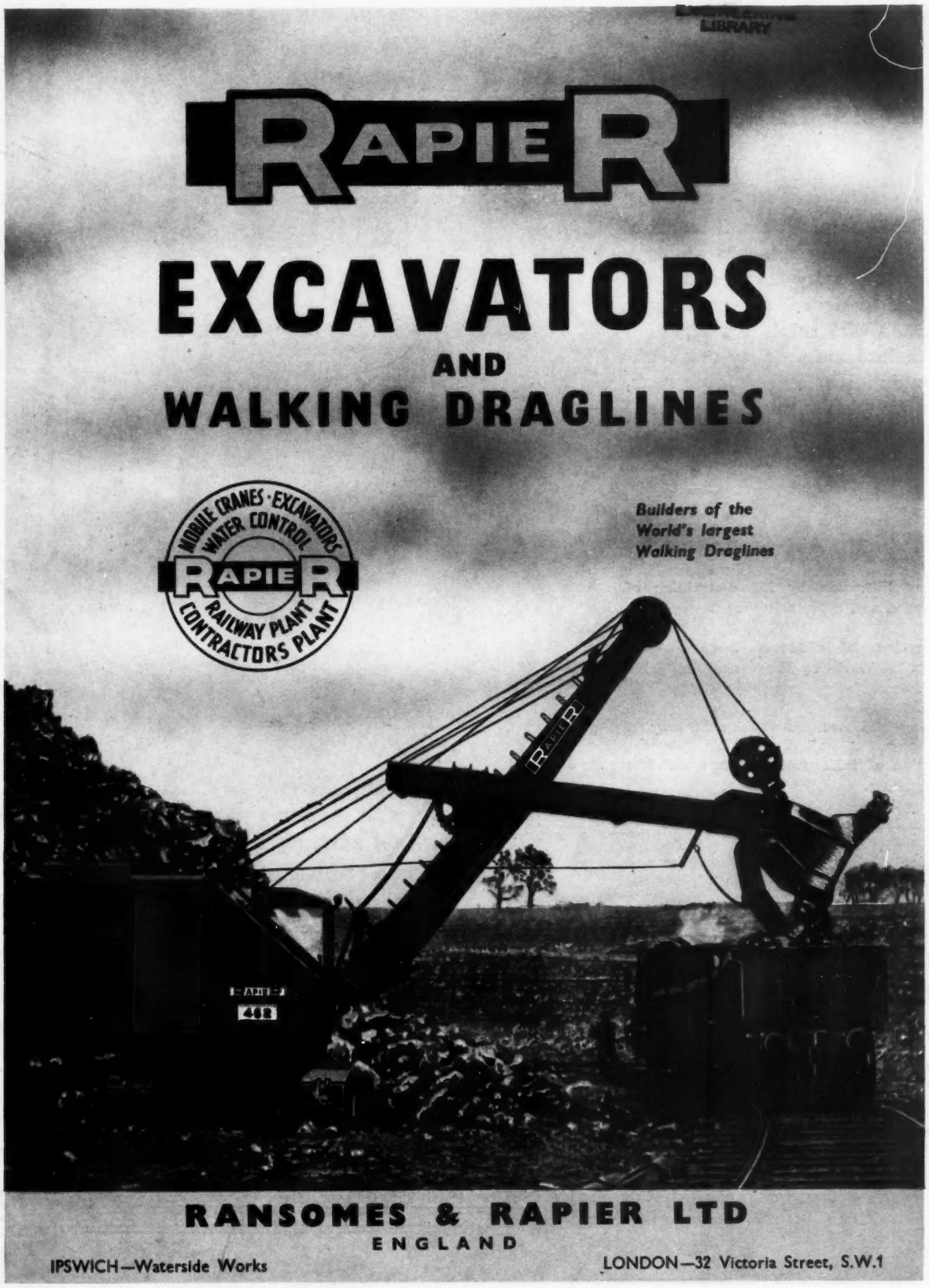
VOL. CXCV—JANUARY TO JUNE, 1953

London:
28, ESSEX STREET, STRAND, W.C.2

The Engineer

JANUARY 2, 1953 28, ESSEX ST., STRAND, LONDON, W.C.2 TWO SHILLINGS

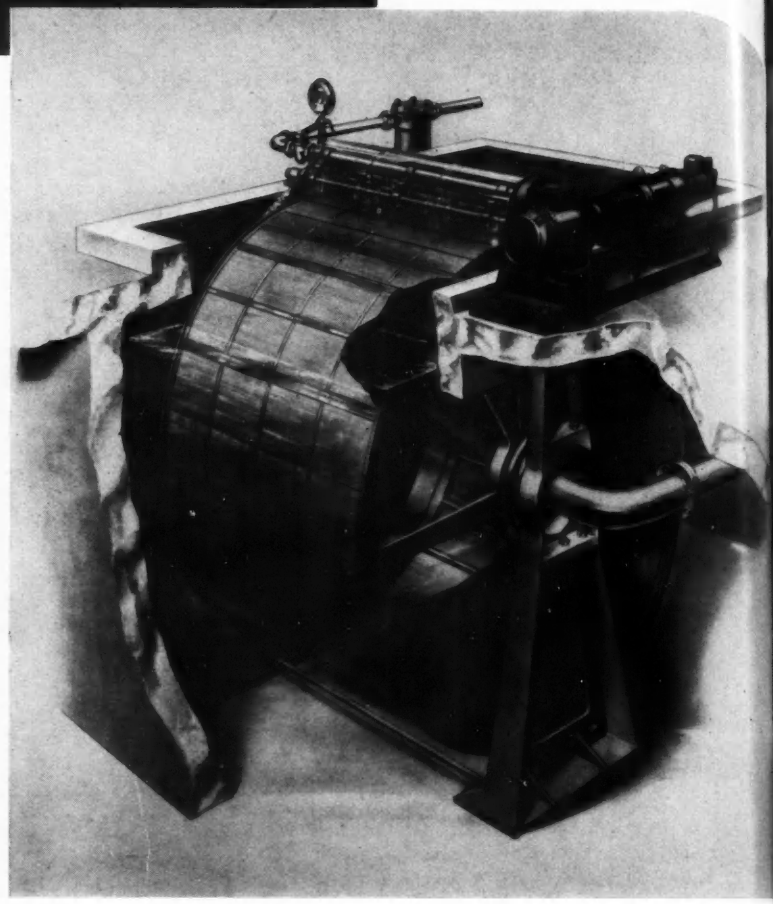
UNI. OF MICHIGAN
JAN 19 1953
LIBRARY



PATENT MICRO-STRAINERS

and other Automatic Rotary Strainers

FOR SINGLE AND MULTIPLE UNIT INSTALLATIONS



Glenfield Automatic Strainers are of the self-cleaning rotary drum type for open gravity flow conditions, and are designed for continuous operation with minimum attention and maintenance. They are economical in initial and running costs, space occupied is small and overall head required is reckoned in inches, even for the largest flows.

Typical Applications

Primary Filtration by Micro-straining of impounded and other waters.

Clarification of effluents from Sewage Purification Works by Micro-straining prior to discharge.

Straining and Screening of crude sewage.

Protection of inlet works, pumps, culverts and pipelines.

Clarification of condenser cooling water.

Straining of industrial water supplies and effluents.

We are always glad to study in detail new problems and to co-operate with engineers who wish to apply straining plant to the best advantage.

Our publication, "Automatic Rotary Straining Plant and Micro-straining Plant," is available to responsible engineers and a working model of a Glenfield Micro-straining unit can be seen by arrangement with our Civil Engineer's Department.

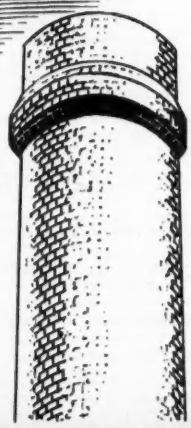
All enquiries relating to Straining Plant should be addressed to

CIVIL ENGINEER'S DEPARTMENT
105 PARK STREET, LONDON, W.1

Glenfield

GLENFIELD & KENNEDY, LIMITED, KILMARNOCK

POWER FOR INDUSTRY



CLARKE, CHAPMAN WATER-TUBE BOILERS have been installed in industrial plants in all parts of the world, designed on the latest modern practice and suitable for high pressures and heavy duties. This design and manufacturing experience which has contributed to some of the largest power stations in the country is at the disposal of any firm interested in steam generating plant. A recent installation is shown in the illustration of the Water-Tube Boiler installed for Messrs. Caldwells Paper Mills Ltd., Inverkeithing, the capacity of which is 42,000 lb. steam per hour.

Clarke, Chapman
BOILERS

CLARKE, CHAPMAN specialise in the design and manufacture of all kinds of welded pressure vessels for the petroleum, chemical and other industries. Our workshops are equipped with new plant for the efficient fabrication, heat treatment and rigorous radiographic examination of fusion welded vessels to the requirements of the principal surveying authorities in this country.

CLARKE, CHAPMAN & CO. LTD. · VICTORIA WORKS · GATESHEAD 8 · CO. DURHAM
Telephone: Gateshead 72271 (10 lines) Telegrams: 'Cyclops' Gateshead
London Office: Fenton House, 112/113 Fenchurch Street, E.C.3.
Telephone: Royal 2737/8 Telegrams: 'Cyclope' Fen, London

THE ENGINEER

ESTABLISHED 1856

Vol. 195 No. 5058

JANUARY 2, 1953

28 Essex Street, Strand, London, W.C.2

Telephone : CENtral 6565 Telegrams : Engineer Newspaper, Estrand, London

Published every Friday Registered as a Newspaper

PRINCIPAL CONTENTS

(Complete contents on page 20)

A Retrospect 20

Civil Engineering in 1952—No. I 3

The Royal Navy, 1952—No. I 5

British-Built Locomotives of 1952—No. I 2

Electrical Engineering in 1952—No. I 26

Shipbuilding and Marine Engineering in 1952—No. I 16

The British Iron and Steel Industry in 1952—No. I 30

Aeronautics in 1952—No. I 24

NOTICE TO READERS

All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

SUBSCRIPTIONS

U.K. & ABROAD £5. 10. 0. CANADA £5. 5. 0. annually including postage. Every subscriber is entitled to one FREE copy of the DIRECTORY & BUYERS GUIDE as published—extra copies 5s. each post free.

CLASSIFIED ADVERTISEMENTS

LINEAGE RATE (Under 1 inch):—2s. 6d. per line of 6 words. Minimum 10s.

INCH RATE (1 inch and over):—Rates per insertion per single column inch—1 insertion—30s. 6 insertions—27s. 13 insertions—26s. 26 insertions—25s.

USE OF BOX NUMBER: The charge is 2s. including the cost of re-addressing replies, which are forwarded immediately on receipt. N.B. There is no Charge for Box Nos. under "Situations Wanted."

WORDING OF ADVERTISEMENTS: Approximately the first 25 letters of each advertisement are set in heavy type. Advertisers are therefore advised to begin their advertisements with the words they want emphasized.

Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

INDEX TO ADVERTISERS—PAGE 107

PUBLIC APPOINTMENTS

UNIVERSITY OF BELFAST

LECTURESHIP IN CIVIL ENGINEERING

The Senate of the Queen's University of Belfast invites applications for a LECTURESHIP in CIVIL ENGINEERING from 1st October, 1953. Salary range £550 by £50 to £1150 with contributory pension rights under the F.S.S.U. Initial placing on the scale will depend on experience and qualifications. Applications should be received by 15th March, 1953.—Particulars from G. R. Cowie, M.A., LL.B., Secretary. E6725

LONDON COUNTY COUNCIL

BRIXTON SCHOOL OF BUILDING

SENIOR LECTURER IN STRUCTURAL ENGINEERING

Brixton School of Building. SENIOR LECTURER in STRUCTURAL ENGINEERING, graduate, Corporate Member of professional institution, with responsible professional and preferably teaching experience. Burnham scale salary £1076 by £25 to £1238.—Application forms from Secretary of School, Ferndale Road, S.W.4, returnable by 17th January, 1953. (1290) E6710

SURREY COUNTY COUNCIL

EDUCATION COMMITTEE

WIMBLEDON TECHNICAL COLLEGE, GLADSTONE ROAD, S.W.19

LECTURER IN MECHANICAL ENGINEERING

Applications are invited for the post of LECTURER in MECHANICAL ENGINEERING, principally for Heat Engines and Applied Mechanics, and possibly Theory of Machines. Preference will be given to Graduates who are also Corporate Members of the Institution of Mechanical Engineers, and previous teaching experience will be an additional recommendation.

Salary will be in accordance with the Burnham Scale for Lecturers in Technical Colleges : men, £940 by £25 to £1040 p.a., plus London allowance.

The successful candidate will be required to commence duties as soon as possible.

Details, indicating the form of application may be obtained from the Principal, to whom completed application should be sent within three weeks of the appearance of this advertisement. E6734

THE COLLEGE OF AERONAUTICS

DEPUTY HEAD OF DEPARTMENT OF AIRCRAFT PROPULSION

Applications are invited for the post of DEPUTY HEAD OF DEPARTMENT OF AIRCRAFT PROPULSION. Candidates should have good academic qualifications and recent experience of modern aero-engine developments. The successful candidate will be required to assist the Head of the Department in organising instruction, directing research and controlling staff. In addition, the post demands specialised knowledge of project design. Some experience of vibration and stressing, or allied subjects an advantage. Present salary is up to £1400 per annum, with superannuation and family allowances, but an extension of the scale to £1600 per annum is under consideration. Modern house available.—Applications, with names and addresses of not more than three referees, to the Registrar, The College of Aeronautics, Cranfield, bletchley Bucks. Further particulars available if required. E6736

HERTFORDSHIRE COUNTY COUNCIL

HATFIELD TECHNICAL COLLEGE

TECHNICAL AND DESIGN ENGINEERING DEPARTMENT

LECTURERS

Applications are invited for the following posts in the above new and expanding College. Industrial or research experience desirable for all posts.

(1) LECTURER in MECHANICAL ENGINEERING. Applicants should be graduates, able to lecture in thermodynamics to H.N.C. and Degree standard, and be qualified to develop the heat engines laboratory. Details of subsidiary subjects offered should be given. Industrial experience in I.C. engines or gas turbines is desirable.

(2) ASSISTANT LECTURER, Grade B, in ELECTRICAL ENGINEERING. Candidates should be graduates in electrical engineering and be qualified to teach telecommunications and/or electronics to Degree or H.N.C. standard.

(3) ASSISTANT LECTURER, Grade B, in MECHANICAL or AERONAUTICAL ENGINEERING, to teach up to H.N.C. standard. Applicants should preferably possess a Degree and be Corporate Member of a professional society. Teaching duties will be mainly concerned with mechanical engineering subjects, but experience in aeronautical engineering will be an advantage. All staff at the College will be encouraged to undertake research or development work.

Salary scales : Lecturer, £940 by £25 to £1040 ; Assistant Lecturer, Grade B, £490 by £25 to £765, plus additions for training and experience.

Application forms (stamped, addressed envelopes) may be obtained from Registrar, Hatfield Technical College, Roe Green, Hatfield, Herts, and completed forms should be returned as soon as possible. E6766

PUBLIC APPOINTMENTS

SUDAN GOVERNMENT

PUBLIC WORKS DEPARTMENT

ROAD ENGINEER (SURVEYS)

The Public Works Department requires a ROAD ENGINEER (Surveys) for service in the Sudan. Candidates should be between the ages of 30 and 45 and should have had extensive experience in road survey and location, particularly of low-cost roads in overseas territories, including soil analysis and testing. Experience of the construction of low-cost roads with modern mechanical equipment essential. Degree and/or Corporate Membership of a recognised Engineering Institution an advantage.

Under the direction of the Chief Road Engineer, the duties will be the location, design and settling out of earth, gravel, stabilised soil and asphalt roads and associated bridging.

Appointment will be on short-term contract (without bonus) for three years at a fixed salary of £E2000 per annum plus a variable cost-of-living allowance, reviewable quarterly, the rate at present being approximately £E14 per month. There is at present no income tax in the Sudan. Annual home leave on a generous scale after initial tour of approximately 18 months. Free passages both ways by air for official and family. Duty transport provided. Government accommodation, as available, provided at low rent. Outfit allowance of £E50 payable when the contract is signed.

Further information and application form will be sent on receipt of a postcard only, addressed to the Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, quoting " Road Engineer (Surveys) 1806S " and name and address in block letters. E6724

GOVERNMENT OF KUWAIT

DIESEL POWER STATION SHIFT ENGINEER

DIESEL POWER STATION SHIFT ENGINEER required for service with the Government of Kuwait, Persian Gulf. Applicants should have some technical qualification and should not be more than 35 years of age. He should have good experience in the operation and maintenance of diesel engines and generators, and also have sufficient electrical knowledge of an A.C. distribution system to be able to operate the power plant in the station efficiently. Steam power plant operation experience would be advantageous, as at a later date a steam power station will be operating, and it might be possible to transfer the services of the diesel power station shift engineers over to the steam station. The starting consolidated salary offered is at the rate of £1500 per annum, according to experience. Free furnished quarters and free medical attention are provided. The first year will be probationary, and, if satisfactory, home leave will be granted at the end of three complete years' service. Married accommodation cannot be promised within one year.—Applications, stating age and giving full details of experience, should, in the first instance, be addressed to the Secretary, Ewbank and Partners, Limited, 10/11, Grosvenor Place, London, S.W.1. E6726

KENT COUNTY COUNCIL

BUILDINGS DEPARTMENT

ENGINEERING INSPECTOR

Applications are invited for the appointment in the Buildings Department of an ENGINEERING INSPECTOR at a salary in A.P.T. Grade V (£595–£645).

Applicants must have had good practical experience in the design and installation of equipment in one or more of the following, viz., (a) electrical installations for buildings, (b) low-pressure hot water heating and domestic hot and cold water systems, (c) steam services associated with heating and cooking installations.

Preference will be given to Members of the Institution of Heating and Ventilation Engineers or the Institution of Electrical Engineers.

Applications, on forms obtainable from the County Architect, Springfield, Maidstone, must be delivered to him within fourteen days of the appearance of this advertisement.

W. L. PLATTS,
Clerk of the County Council.

County Hall, Maidstone,
12th December, 1952. E6713

GOVERNMENT OF KUWAIT

DIESEL POWER MAINTENANCE ENGINEER

DIESEL POWER MAINTENANCE ENGINEER required for services with the Government of Kuwait, Persian Gulf. The minimum technical qualification required is the Higher National Certificate in Mechanical Engineering or its equivalent, and age should be from 30 to 35 years. Applicants should have had good experience in diesel generating stations in an administrative position, and be capable of supervising maintenance and operating the station at the highest possible efficiency. Applicants must have some electrical knowledge and experience of some steam power plant would be advantageous, as at a later date the steam power station is to be commissioned and, if suitable, a transfer could be arranged. The salary offered is up to £1650 per annum, according to experience. Free furnished quarters and free medical attention are provided. The first year will be probationary and home leave will be granted at the end of two years' service. Married accommodation cannot be promised during the first year of service.—Applications, stating age and giving full details of experience, should, in the first instance, be addressed to the Secretary, Ewbank and Partners, Limited, 10/11, Grosvenor Place, London, S.W.1. E6727

PUBLIC APPOINTMENTS

SUDAN GOVERNMENT

PUBLIC WORKS DEPARTMENT

ROAD ENGINEER

The Public Works Department requires a ROAD ENGINEER for service in the Sudan. Candidates should be between the ages of 28 and 43 and should have wide knowledge of all kinds of road construction and bridging, particularly the construction of low-cost roads with modern mechanical equipment. Contracting experience would be a decided advantage, as would also be Corporate Membership of the Institution of Civil Engineers.

Under the direction of the Chief Road Engineer the duties will be the construction of earth, gravel, stabilised soil and asphalt roads, including the design of bridging, culverting and surface drainage and administration and control of site staff.

Appointment will be on short-term contract (without bonus) for three years at a fixed salary of £E2000 per annum plus a variable cost-of-living allowance, reviewable quarterly, the rate at present being approximately £E14 per month. There is at present no income tax in the Sudan. Annual home leave on a generous scale after initial tour of approximately 18 months. Free passages both ways by air for official and family. Duty transport provided. Government accommodation, as available, provided at low rent. Outfit allowance of £E50 payable when the contract is signed.

Further information and application form will be sent on receipt of a postcard only, addressed to the Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, quoting " Road Engineer 1806 " and name and address in block letters. E6723

SUDAN GOVERNMENT

PUBLIC WORKS DEPARTMENT

PLANT MANAGER

The Public Works Department requires a PLANT MANAGER for service in the Sudan. Candidates should be between the ages of 35 and 40 years and should have had extensive experience in maintaining and operating roadmaking machinery and heavy earth-moving equipment and be capable of training operating personnel. Experience of the above on low-cost roads under overseas conditions highly desirable. Corporate Membership of a recognised Engineering Institution would be an advantage.

The successful candidate will be responsible to the Chief Road Engineer for the maintenance of all road-making and earth-moving equipment and for training operating staff.

Appointment will be on short-term contract (without bonus) for three years at a fixed salary of £E2000 per annum plus a variable cost-of-living allowance, reviewable quarterly, the rate at present being approximately £E14 per month. There is at present no income tax in the Sudan. Annual home leave on a generous scale after initial tour of approximately 18 months. Free passages both ways by air for official and family. Duty transport provided. Government accommodation, as available, provided at low rent. Outfit allowance of £E50 payable when the contract is signed.

Further information and application form will be sent on receipt of a postcard only, addressed to the Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, quoting " Plant Manager 1822 " and name and address in block letters. E6721

LONDON ELECTRICITY BOARD

DESIGN AND PLANNING BRANCH

Applications are invited for appointments in the Design and Planning Branch of the Chief Engineer's Department in Central London.

Applicants should have technical qualifications equivalent to Corporate Membership of the I.E.E., and have a wide experience of the design, operation or construction of H.V. and L.V. distribution systems and of the preparation of reports, estimates and specifications.

The commencing salary will be within the ranges of Class AX, Grades 1, 2 or 5, of Schedule " C " of the National Joint Board agreement for Area Boards, plus 5 per cent. for London area, and subsequently will vary in accordance with the classification of the area, which is now DX, subject to the provisions of that agreement. The inclusive ranges within Class AX are : Grade 1, £1018 10s. to £1153 per annum ; Grade 2, £875 14s. to £1018 10s. per annum ; Grade 5, £681 9s. to £829 10s. per annum.

Application forms obtainable from the Establishments Officer, 46/47, New Broad Street, E.C.2, to be returned completed by 10th January, 1953. Please enclose addressed foolscap envelope and quote ref. V/1561/EE on all correspondence. E6731

ABERDEEN HARBOUR COMMISSIONERS

HARBOUR ENGINEER'S DEPARTMENT

JUNIOR ENGINEERING ASSISTANT

Applications are invited for the post of JUNIOR ENGINEERING ASSISTANT in the Harbour Engineer's office, Aberdeen. Applicants should have drawing-office experience in general civil engineering design.

The salary rises, on age scale, from £360 at 25 years, to £450 at 32 years. The appointment is subject to the Commissioners' superannuation scheme, and the candidate selected will require to pass a medical examination before appointment.

Applications, stating age and qualifications, with full details of experience, together with copies of recent testimonials, should be lodged with the Harbour Engineer, 15, Regent Quay, Aberdeen, not later than 15th January, 1953.

Harbour Engineer's Office,
Aberdeen, 20th December, 1952. E6750

PUBLIC APPOINTMENTS

CROWN AGENTS FOR THE COLONIES

MARINE SURVEYS DEPARTMENT

ENGINEER AND SHIP SURVEYOR

ENGINEER and SHIP SURVEYOR required by the Government of Singapore, Marine Department, for one tour of three years in the first instance, with prospect of pensionable employment. Salary (including allowances) payable in local currency equivalent at the present Government rate of exchange to £1279 a year, rising to £2170 a year for single men. Commencing salary according to qualifications and experience. Additional allowances between £222 and £630 a year payable to married men according to salary and dependents. Free passages. Liberal leave on full salary. Candidates must hold either (a) an Extra First Class Certificate of Competency as Engineer in the Mercantile Marine or (b) a First Class Certificate (Steam and Motor) with either a University Degree in Engineering or equivalent qualification or experience ashore as Surveyor or Superintendent Engineer, &c.

Apply at once by letter, stating age, full name in block letters, and full particulars of qualifications, experience, and mentioning this paper, to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting on letter M.33208.E. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E6722

MINISTRY OF SUPPLY

DIVISION OF ATOMIC ENERGY (PRODUCTION)

WORKSHOPS ENGINEER

WORKSHOPS ENGINEER required at Sellafield, Cumberland. Duties : supervision of erection of chemical pilot plant, general machine shop work in co-operation in design of experimental plant. Candidates must have served a recognised engineering apprenticeship and hold A.M.I.Mech.E. or equivalent. Sound knowledge of modern engineering practices, including welding, essential. Salary range £ (age 25)–£833. Voluntary superannuation. Ho within reasonable period, if married.—Applicatio Ministry of Supply, Division of Atomic Energy (P duction), Risley, Warrington, quoting 407. E6

LONDON COUNTY COUNCIL

CIVIL ENGINEERING ASSISTANTS, CIVIL ENGINEERING DRAUGHTSM

London County Council requires (a) CI ENGINEERING ASSISTANTS, (b) CIVIL EN NEERING DRAUGHTSMEN, with experienc (i) main drainage work generally, or (ii) se purification works ; (c) DRAWING-OFF STAFF for making good standard drawings f instructions ; and (d) TRACERS (male and fem Pay up to (a) £675, (b) 200s., (c) 170s., and (d) —Send s.a.e. for application form for return 17th January, to Chief Engineer (52/50), Co Hall, S.E.1. (1336) E6

TENDERS

IRAQ GOVERNMENT

DEVELOPMENT BOARD

ROAD BRIDGES AT BAGHDAD

1. TENDERS are invited by the Developm Board of the Government of Iraq for the CO STRUCTION of TWO ROAD BRIDGES over River Tigris at Baghdad and works in connec therewith.

2. The contract documents and instructions t tendering for the first bridge, i.e. South Gate Bri may be inspected on and after the 1st day of Janu 1953, at any of the following places, namely :—

(a) The offices of the Development Boa Baghdad.
(b) The Iraqi Embassy, Washington, D.C., US
(c) The Royal Iraqi Legation, Paris.
(d) The Royal Iraqi Legation, Brussels.
(e) The Royal Iraqi Legation, Rome.
(f) The offices of Messrs. Coode and Partners Victoria Street, London, S.W.1, England.

Similar documents for the second bridge, Adhamiyah Bridge, will be available after the 1st day of February, 1953.

3. Firms desiring to Tender may obtain copies the contract documents for the first bridge betw the 1st day of January, 1953, and the 31st day March, 1953, and for the second bridge on or a the 16th day of February, 1953, and until the 31st of March, 1953, from either the Development Boa in Baghdad or Messrs. Coode and Partners in Lon upon payment of twenty-five Iraqi Dinars or twenty-five pounds sterling for each set of docume

4. Tenders must be accompanied by a deposit I.D. 10,000 (ten thousand Iraqi Dinars) for e bridge or the equivalent in pounds sterling, to be m at the Rafidain Bank, Baghdad, or at its Lond agents, the Midland Bank, Overseas Branch, 122, Broad Street, London, E.C.2. Full detailed co ditions as to this deposit may be ascertained from " Instructions to Persons Tendering " attached to contract documents.

5. Tenders for one or both bridges must be s mitted to the Development Board, Baghdad, and be received up to noon on the 30th day of April, 19

6. Particular attention is drawn to Article 22 of Instructions to Persons Tendering, namely, " Tenders will only be accepted from firms of co tractors who have previously executed works of similar nature and magnitude.

SECRETARY GENERAL,
Development Board
Baghdad. E67

THE ENGINEER

JANUARY 2, 1953

Professor A. H. Jameson

WE record with deep regret the death of Emeritus Professor Alexander Hope Jameson, M.Sc., which occurred suddenly at his home at Worthing, Sussex, on December 23rd. Professor Jameson, who was seventy-eight, occupied the Chair of Civil Engineering at King's College, University of London, from 1912 until 1935. He was born in London and was educated privately and at Owens College, Manchester, subsequently becoming—for a period of three years from 1894 to 1897—Bishop Berkeley Fellow and Demonstrator in the Whitworth Engineering Laboratory. Jameson then joined the drawing-office staff of the Lancashire and Yorkshire Railway, and between 1897 and 1901 served as assistant to the railway's resident engineers at Halifax and Wakefield. In the latter year, he was appointed engineering assistant to the Derwent Valley Water Board, and for some years following acted first as resident engineer for the Derwent Aqueduct and then on the Thirlmere Aqueduct during the installation of the third pipeline. In 1912, Professor Jameson began his long and distinguished career as a teacher of engineering, being appointed to the Chair of Civil Engineering in the University of London, which was tenable at King's College. During the latter part of his time at King's College, Professor Jameson was also Dean of the Faculty of Engineering. On relinquishing that office and the Chair of Civil Engineering in 1935, the University of London conferred upon him the title of Emeritus Professor. Professor Jameson was elected an associate member of the Institution of Civil Engineers in 1901 and a member in 1912. He was a Miller prizeman and James Forrest medallist of the Institution, and contributed many papers to its Proceedings dealing with the strength of materials and with the engineering problems associated with the construction of weirs, reservoirs and aqueducts. Professor Jameson was also the author of several standard textbooks on geometry, surveying and fluid mechanics.

Distribution of Primary Copper

A NOTE issued by the Copper-Zinc-Lead Committee of the International Materials Conference announces that member governments have accepted its proposal for an allocation of copper for the first quarter of 1953, subject to a review of the supply and demand situation at the end of this month, to ascertain whether the allocation need be continued for the remainder of the quarter. It is pointed out that although there has been an easing of the copper market in recent months, the reported requirements of primary copper for the first quarter of 1953 exceeded the estimated quantity available. It was estimated that during the first quarter of the year there would be 704,790 metric tons of primary copper available and the committee recommended that 723,080 metric tons should be distributed. There is an apparent over-allocation of 18,290 metric tons, which is designed to provide a measure of flexibility to the distribution plan. Only primary copper (blister and refined) is included in the distribution plan and as in previous quarters semi-fabricated products have not been allocated. All exporting countries have again been asked to maintain their exports of semi-fabricated products at levels commensurate with their allocation of primary metal for civilian consumption in accordance with the normal patterns of trade. Direct defence needs have been given priority in the plan. The twelve countries represented on the committee are Australia, Belgium (representing the Benelux countries), Canada, Chile, France, Germany, Italy, Mexico, Norway, Peru, the United Kingdom and the United States. The plan of distribution has been forwarded also to twenty-seven other countries not represented on the committee but for which allocations have been recommended.

Extension of Aircraft Production Priority Scheme

IT was announced by Mr. Sandys, the Minister of Supply, on Tuesday last, that the super-priority scheme for aircraft production was to be extended to three civil gas turbine aircraft. These aircraft are the de Havilland "Comet," with turbo-jet engines, and the Vickers "Viscount" and Bristol "Britannia," with propeller turbine engines. By extending such priority to the sphere of civil aviation it was hoped to emphasise, the Minister commented, the Government's determination to help the British aircraft industry to expedite deliveries and thus exploit fully the "remarkable technical lead which it possesses at present over all other countries." The scheme has also been extended to include the Avro "Vulcan" delta bomber and the Handley Page "HP 80" "crescent wing" bomber, which first flew last week. There are now three four-engined jet-bomber aircraft under super-priority production which, although amongst the heaviest aircraft flying, are classified as medium bombers. All differ radically in design. Other aircraft included in the scheme are the Gloster "Javelin" delta aircraft, the Hawker "Hunter," the Vickers "Swift," the Fairey "Gannet," anti-submarine aircraft, and the English Electric "Canberra" twin-engined bomber. The Handley Page aircraft completes the present series of jet bombers with which the Royal Air Force is to be equipped.

The Size of Manufacturing Firms

IN accordance with the provisions of the Statistics of Trade Act, 1947, the Ministry of Labour regularly collects information concerning the number of manufacturing establishments in Great Britain with more than ten employees. A survey of this information relevant to the month of May last has recently been completed and is published in the latest issue of the *Ministry of Labour Gazette*. This survey reveals that of the 56,638 manufacturing establishments from which particulars were received, 42,644 (or 75 per cent) each had fewer than 100 employees, and that 8364 establishments (or 15 per cent) were each employing between 100 and 250 people. There were 619 establishments in which the employees numbered from 1000 to 2000; 290 establishments employing between 2000 and 5000 people, and seventy-one establishments employing more than 5000. The manufacturing establishments classified in the survey under the heading "engineering, shipbuilding and electrical goods," numbered 8563. In 2303 of them there were between eleven and twenty-four employees in May, 1952; in 3579 there were between twenty-five and ninety-nine; in 1942 establishments the employees numbered from 100 to 499; in 391 establishments there were between 500 and 1000; in 228 there were between 1000 and 2000, and 120 establishments were each employing 2000 or more people.

Blea Moor Derailment Report

THE Ministry of Transport report has now been issued on the derailment of the 9.15 a.m. up Thames–Clyde express train at Blea Moor on April 18th last year. This derailment occurred as the train was passing over the facing points at Blea Moor at a speed of some 55 m.p.h. A brake rod on the tender of the leading of the two locomotives hauling the train became detached and caught in the points, forcing open the closed switch rail. As a result the second locomotive and first four coaches turned over on their sides and the four following coaches were derailed. There were no fatalities as a result of the derailment, but twenty-nine passengers and five railway employees were injured. The report concludes that the brake rod on the tender came adrift because of bad maintenance of the engine. The round pin holding the rod to the brake shaft became displaced as a result of the securing split pin having dropped out of position. This split pin was not found and it was not possible to say in what way it was defective, but it is stated there was no doubt that there was some defect, for a well-fitting pin with correctly splayed legs would not fall out of its own accord. The wear marks on the round pin concerned indicated that the split pin could not have been a good fit and that its condition was like that on the other brake rod—which was far from good. The accident is attributed to the fact that insufficient attention had been paid over a considerable period to the examination of the brake gear.

Training Courses for Foremen

LAST year the Institute of Industrial Supervisers, in collaboration with the Department of Industrial Administration at the College of Technology, Birmingham, developed four residential course programmes designed to be of direct help to foremen. These courses were planned to promote the exchange of experience by the discussion of case studies and by practical exercises and demonstrations, in addition to the direct presentation of information. As a result of the enthusiastic response, the Institute plans to extend the courses. The four residential course programmes developed are as follows: the practice of supervisory management, human relations, communication and discipline for supervising management, work study for supervisory management, and industrial relations and industrial law—what the superviser should know. The programmes will be repeated at residential centres throughout the country at regular intervals during the year. Experience has shown that to obtain the maximum benefit from discussion on the courses, attendance should be limited to thirty students of similar experience and responsibilities, although these may be drawn from varying industries. The courses have proved to be of assistance for the medium-sized and smaller companies for whom little has been done in the field of residential training. To avoid key personnel from companies being away from vital duties, Institute courses are planned for week-ends and usually commence on Friday evenings and conclude on Sunday afternoons. Details of the courses can be obtained from the Institute offices at 47, Temple Row, Birmingham, 2.

The Ewing Medal

AT the ordinary meeting of the Institution of Civil Engineers on December 16th last the president, Mr. H. F. Cronin, announced that the council of the Institution had awarded the James Alfred Ewing Gold Medal for 1952 to Professor J. F. Baker, of Cambridge University. The medal, the president said, had been founded in 1936 in memory of Sir Alfred Ewing, an honorary member of the Institution, and the income from the endowment fund was to be expended in the provision of a gold medal to a person, whether a member of the Institution or not, for specially meritorious contributions to the science of engineering in the field of research. The award was made in recognition of Professor Baker's researches in structures.

British-Built Locomotives of 1952

EARLY last year two further classes of standard steam locomotives were introduced on British Railways, and it is of interest to note that about half of the new engines turned out by the railway workshops were to the standard designs. A shortage of materials is stated to have restricted new construction to a large measure, but it is evident that as the position eases increasing numbers of standard locomotives will be introduced into service.

The larger of the two new standard designs introduced in 1952 was the 4-6-2 class "6" for fast freight and passenger train service, and under the 1951 renewal programme ten of these engines were built for the Scottish Region. As can be seen from the middle photograph reproduced on Plate 4, the new engines are very similar in appearance to the class "7" "Britannia" locomotives. They have a chassis similar in most respects to the "Britannia" class, but are fitted with a smaller boiler to restrict the axle load to 19 tons. Their two cylinders are 19½in by 28in and the boiler working pressure is 225 lb per square inch. With a total weight of 88 tons 10 cwt in working order the new locomotives have a tractive effort of 27,520 lb. In keeping with the locomotive standardisation scheme, the class "6" engine in addition to its main frames, has, axleboxes, springs and suspension, cylinders and valve gear, bogie and pony truck, cab, and many other parts similar in all respects to the class "7" locomotives.

The new standard class "3" 2-6-2 tank engines, of which twenty were built, are designed to replace a number of tender and tank locomotives now becoming obsolete. These locomotives, like the class "4's" introduced last year, have almost universal availability over the main and secondary lines of the country. In full working order each of these locomotives weighs just over 74 tons and has a tractive effort of 21,490 lb. In keeping with present locomotive practice on British Railways, many of the aspects of design are similar to other standard types—the class "4" in particular—to give a high degree of component interchangeability.

An event of particular interest and importance in 1952 was the introduction to service of the Metropolitan Vickers gas turbine electric locomotive on the Western Region. Details of this locomotive and notes on the work which lead up to its design were given in our issues of February 1 and 15, 1952. As a matter of interest we reproduce a photograph of this locomotive on Plate 2 and give the following table of its principal dimensions.

Length over buffers	66ft 9in
Bogie wheel base	15ft
Bogie centres	37ft 6in
Total wheel base	53ft
Body width	9ft
Height above rail	12ft 6in
Total weight	130 tons
Maximum tractive effort	60,000 lb
Continuous rating tractive effort	30,000 lb

This locomotive was designed to haul trains weighing 780 tons at speeds up to 90 m.p.h. Its gas turbine, when delivering full load, rotates at 7000 r.p.m. and drives three main traction generators at 1600 r.p.m. through single reduction gearing. In this reduction gear unit one of the two output shafts drives two main generators and the other drives a third main generator, the auxiliary generator and the exciter. Each of the three main generators supplies current to two of the six traction motors.

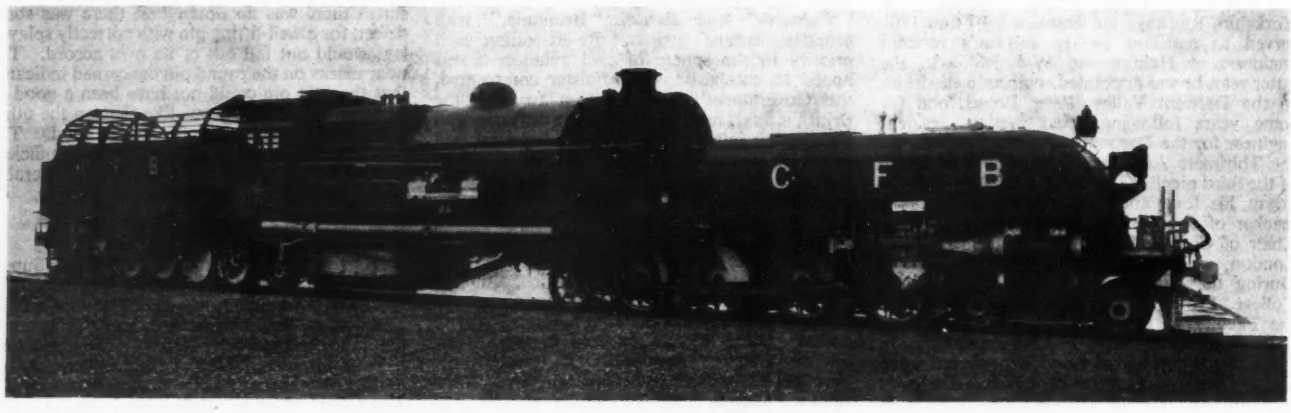
During the early part of the year this gas turbine locomotive was subjected to an extensive series of tests and early in April last went into regular passenger service between London and Bristol, hauling the "Merchant Venturer" and "Bristolian" expresses. It was subsequently transferred to the London-Plymouth route, where it has latterly been working on a 600 miles-a-day schedule and by the middle of last month it had covered some 55,000 miles.

The works of private locomotive manufacturers were kept busy throughout the year on orders from overseas and, despite the difficulties in the supply of materials experienced by some of the firms, an appreciable number of locomotives were shipped.

Amongst the larger locomotives built for overseas which were described in these columns in 1952 was the first of fifty 4-8-4 +4-8-4 Beyer-Garratt articulated engines, built by Beyer, Peacock and Co., Ltd., for the New South Wales Government Railways. These locomotives, weighing some 255 tons each in working order and measuring nearly 109ft over buffers, rank amongst the most powerful engines built in Europe. Despite their great weight, the engines have a coupled axle load of only 16 tons, and with their ability to negotiate curves of 6 chains they will be able to work over practically the whole of the New South Wales railway system.

As a result of the successful performance in service of a number of 3ft 6in gauge 4-8-2+2-8-4 Beyer-Garratt locomotives with a 13-ton axle load, which were built for the Benguela Railway in 1926, fourteen more of these engines were ordered in 1929, and last year a further eighteen similar locomotives were supplied. These new locomotives, one of which is illustrated on this page, have the same tractive effort of 52,360 lb at 85 per cent boiler pressure as their predecessors, but they embody a number of improvements in design. The boiler, which has a working pressure of 180 lb per square inch, has a Belpaire firebox with a large deep grate, 51·5 square inches in area, designed for burning wood fuel.

In the new locomotives the original underhung springs have been replaced by overhung springs and the whole unit chassis has been considerably strengthened. The 18½in diameter, 24in stroke cylinders are cast solid with the half-frame stay and the original design has been modified by straightening the steam passages to increase the steam flow. Other modifications include the elimination of tail rods for the main pistons and the piston valves; the replacement of the two-bar crosshead arrangement by Laird design crossheads; the use of a new method of locating and fastening down of the front and hind tanks, and many alterations have been made in the lubricating arrangements.



4–8–2+2–8–4 Beyer-Garratt Locomotive for Benguela Railway

Amongst the steam locomotives being built at the Springburn, Glasgow, works of the North British Locomotive Company, Ltd., deliveries were started during the year of sixteen 4–8–2 "J9" class engines for the New Zealand Government Railways; sixteen 2–8–2 class "29" locomotives for the East African Railways; one hundred "Y.P." class 4–6–2 and nineteen "180" class 2–8–2 locomotives for the Indian Railways.

The locomotives for New Zealand are a modification of the existing "J" class built by the same firm in 1939, and are arranged for burning oil fuel. Intended for mixed traffic working on 3ft 6in gauge track laid with 50 lb rail, these engines have a maximum axle load of 11½ tons.

The design of the class "29" locomotives for the East African Railways is based upon that of the 3ft 6in gauge "River" class in service on the Nigerian Railways. Their construction is of some interest because at present the gauge of the East African Railways is 3ft 3⅜in, but, as it is contemplated that at some future date the gauge may be increased to 3ft 6in, provision has been made for the conversion of the new engines with a minimum amount of modification. In full working order these locomotives weigh just under 74 tons and they have a tractive effort at 85 per cent boiler pressure of 29,835 lb. One of these engines was described in our issue of January 18, 1952.

Three metre-gauge, 2–8–4 tank locomo-

tives designed for oil firing were delivered to the Iraq Petroleum Company by Hudswell Clarke and Co., Ltd. Although these engines are for service on the oil company's privately owned lines, they will be maintained by the Iraq State Railway, and for this reason as many parts as possible have been made similar to corresponding parts of existing locomotives used on the main railway system.

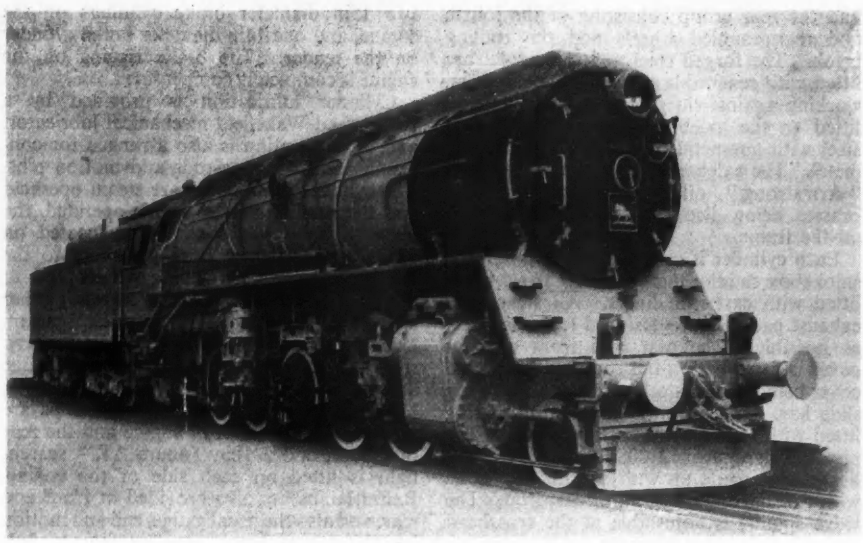
Some of the leading particulars of these engines are as follows :—cylinders, 15½in diameter by 22in stroke ; boiler pressure, 180 lb per square inch ; tractive effort at 85 per cent boiler pressure, 18,800 lb ; axle loading, 9½ tons ; total weight in working order, just over 58 tons. The cylinders are fitted with cast iron barrel liners, and long travel 8in piston valves are actuated by Walschaerts valve gear.

Of seventeen steam locomotives built by W. G. Bagnall, Ltd., of Stafford, for the Gaekwar's Baroda State Railway—now included in the Western Railway of India—seven were 3ft 3⅜in gauge " A " class and ten were 2ft 6in gauge " ZB " class engines. These 4–8–0 " A " class engines, with a total weight of 34½ tons in full working order, have a tractive effort of 14,976 lb at 85 per cent boiler pressure. The 2–6–2 " ZB " class weigh 27½ tons in working order and have a tractive effort of 10,368 lb.

The works of Robert Stephenson and Hawthorns, Ltd., have been fully engaged in building locomotives for home and abroad. At the Darlington works of the firm twenty " 9400 " class tank engines were built for the Western Region of British Railways, and an order for eighty similar engines was almost completed at its Newcastle works. An order for ten prototype " YL " class locomotives for the Indian Railways was placed with the company, and it also delivered three 2–8–2 locomotives built for the 3ft 5½in gauge former Hedjaz Railway in Jordan.

These locomotives for Jordan, one of which is illustrated on this page, are built for oil-fuel firing and are fitted with Laidlaw Drew oil-burning equipment. This firing equipment consists of a refractory lined fire pan fitted with tubes to admit air and attached to the foundation ring. A vertical oil burner is set centrally in the fire pan. The leading particulars of the locomotives are : cylinders, two, 17in diameter by 24in stroke ; coupled wheel base, 13ft 5in ; total heating surface, 1691 square feet ; grate area, 26 square feet ; boiler pressure, 180 lb per square inch ; weight in full working order, 55 tons 12 cwt ; tractive effort at 85 per cent boiler pressure, 22,110 lb.

In addition to twenty 2–8–0 locomotives for Egypt and six 2–8–2 locomotives for the East African Railways, the Vulcan Foundry, Ltd., of Newton-le-Willows, delivered a number of 2–10–2 engines to Iran in fulfilment of a contract negotiated in 1950. The engines built for Egypt were similar in many respects to the L.M.S. type now in service in that country, and they were designed for oil-fuel firing. The E.A.R. locomotives were a modified version of locomotives originally built by the company in 1925, and they were built in conjunction with Robert Stephenson and Hawthorns, Ltd., which supplied many of the detail parts.



2–10–2 Locomotive for Iranian State Railway

The locomotives for the Iranian State Railway, sixty-four of which are to be built, are of a new design, and we reproduce a photograph of one on this page. They are designed to deal with trains of 590 tons on a grade of 1·5 per cent or 296 tons on a grade of 2·8 per cent, where there are curves of 722ft radius. The leading dimensions of the locomotives, which are built to suit the standard Iranian loading gauge and a maximum axle load of 16·72 tons, are given in a table on this page.

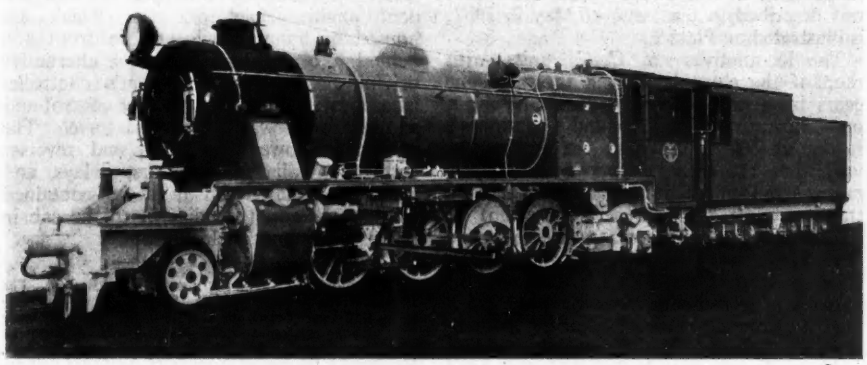
The boiler barrel consists of two courses, the firebox having a round top with an all-welded steel inner box. Four rows of flexible roof stays are provided at the front of the firebox, and flexible stays are also arranged in the breaking zones of the water spaces at the back and sides. The roof stays are arranged radially and the smokebox tube plate has diagonal plate staying, the back plate being stayed by bars fixed to the second barrel plate. The inner firebox is made particularly long to ensure good combustion of the oil fuel without overheating in the region of the firedoor. Two domes are provided on the barrel, the front one, to which is attached the top feed clackboxes, being provided with a tray and baffles for water purification. The rear dome houses an " Owen's " double-beat regulator, which is operated from a handle with ratchet adjustment on the right-hand side of the firebox back plate. A thirty-six element superheater is provided and both the main steam pipes and the smokebox steam pipes are made from solid-drawn steel tubes, the latter being arranged to give a very direct flow of steam between the header and steam chests. The fire-pan is fitted with air doors in the front walls of the two hopper-shaped air intakes and is of all-welded construction.

Leading Particulars of 2–10–2 *Locomotives for Iran*

Cylinders (two)	23·82in × 26in
Coupled wheels	4ft 3in diameter
Leading and trailing truck wheels	2ft 9·07in
Boiler pressure	199 lb. per sq in
Heating surface :	
Large tubes (36), 143mm diameter	895·6 sq ft
Small tubes (181), 54mm. diameter	1614·6 sq ft
Firebox	221 sq ft
Total evaporation	2731·2 sq ft
Superheater (36) elements	868·6 sq ft
Grate area	65·7 sq ft
Tractive effort at 85 per cent boiler pressure	49,200 lb
Adhesive weight	81·65 tons
Factor of adhesion	3·73
Engine : weight in working order	108·49 tons
Tender :	
Water capacity	6600 gallons
Oil fuel capacity	8·4 tons
Wheel diameter	2ft 9·07in
Weight fully loaded	67·27 tons
Engine and tender weight in working order	176·76 tons

Water is supplied by two Davies and Metcalfe " No. 11 A.S.Z." live steam injectors, situated beneath the cab platform, one on each side of the engine, delivering to the boiler at the front dome. Other mountings include three 3in diameter Ross pop safety valves, two " KB-D " Klinger water gauges, boiler and steam chest pressure gauges and three " Williams " blow-off cocks, one of each being located on the purifier dome, mud collector and firebox throat plate respectively.

The rolled steel bar frames are 4·33in thick and extend the full length of the engine bed, being adequately stayed throughout by steel castings and fabricated vertical stretchers. The boiler is supported at the front by the smokebox saddle and at the firebox front by a cast steel bracket with slide. Three expansion plates are provided below the barrel and one at the foundation ring at the firebox back. The overhead spring gear is compensated in two groups, the front group including the leading truck, leading, second and driving coupled wheels



2–8–2 Locomotive for the Hedjaz Railway

and the rear group consisting of the fourth and rear coupled wheels and the trailing truck. The forged steel pedestal guides are fitted with renewable manganese steel liners, working against liners of the same material fitted to the axleboxes, which are of cast steel with gunmetal bushes lined with white metal. The axlebox keeps are provided with "Armstrong" oilers, lubrication to the brasses being also provided from oilboxes on the frame.

Each cylinder is cast integral with half the smokebox saddle, the cylinder barrels being fitted with cast iron liners. All steam and exhaust passages are designed to be as direct as possible. The cast iron front cylinder cover is fitted with a tail rod guide, the hind cover being of cast steel, carrying a single top slide bar. The piston is also a steel casting fitted with four narrow cast iron rings. The piston valves are 12·008in diameter, each head being made up with a main ring fitted with two narrow rings, all of cast iron. The valve spindle is adjustable at the crosshead and the valves are actuated by Walschaerts gear, fitted at all joints with case-hardened mild steel bushes and pins. A cast steel main crosshead has cast iron slippers with white metal inserts. The connecting-rods have small ends with fixed bronze bushes and adjustable big-end bronze bushes lined with anti-friction metal and are also provided with adjusting wedges. The coupling rods are also fitted with solid bronze bushes lined with anti-friction metal.

The coupled wheel centres are of the "SCOA–P" type and are of cast steel with rolled steel tyres secured by locking rings. To help to negotiate the many sharp curves encountered in the Iranian Railways, the distance between the intermediate and driving wheel tyres is made 0·236in less than the leading and trailing, a thin flange being also provided on the driving tyres. The balance weights are cast solid on all except the driving wheel, where lead filling is used to provide the necessary weight. All the rotating weight and a third of the reciprocating weight is balanced.

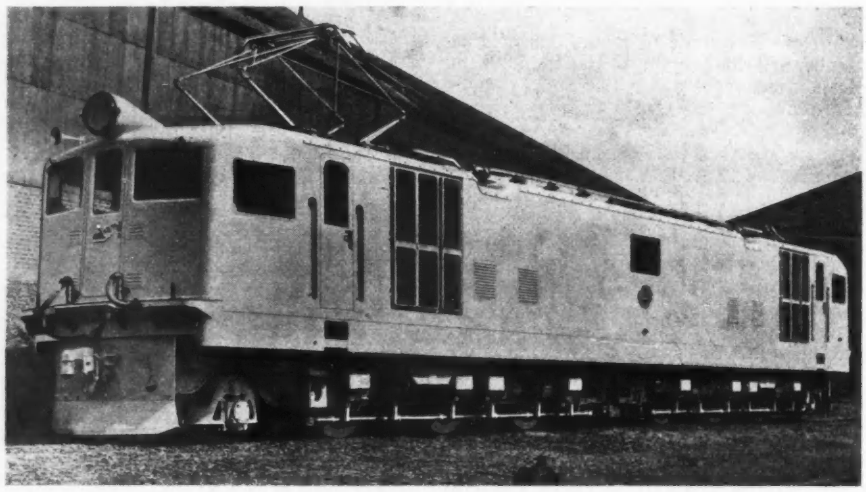
The swing link leading truck has a cannon axlebox fitted with Timken roller bearings. The radial arm trailing truck is spring side controlled and has outside Timken roller bearing axleboxes.

The Westinghouse brake equipment includes a 7in cross-compound type "T.2" air compressor mounted under the platform on the right-hand side of the engine, driver's automatic and independent brake valves, two 15in diameter brake cylinders on the engine, and one 14in diameter brake cylinder on the tender. The brake rigging on the engine is completely compensated.

Cylinder lubrication is provided by a twelve feed Wakefield mechanical lubricator, and oil lubrication is also arranged for connecting and coupling-rods and motion pins. The cylinder drain cocks are steam operated and the sanding valves are air operated, the large capacity sandboxes being located on top of the boiler with supply pipes to the front of leading and driving wheels and to the rear of driving and trailing wheels. Other equipment includes a "Laycock" steam heater and a "Teloc" speed indicator and recorder and a steam chest pressure gauge and pyrometer indicator.

Stones 14in Tonum "E" headlamps are arranged on the front of engine and the rear of tender, and a 10in Tonum "R" searchlight is fitted on each side of the engine. Buffer lamps are also provided at front and rear, and also the usual gauge, cab and motion lamps, current being supplied from a 32V turbo-generator located on the front barrel.

The tender tanks are of welded construction and are carried on an all-welded underframe. The two four-wheel bogies are of the diamond frame pattern with Timken roller bearing axleboxes.



3000V Electric Locomotive for South Africa

Electric and Diesel Electric Locomotives

Early in the year there was completed at the Vulcan works the first of sixty 3600 h.p., 3000V, d.c. electric locomotives, which the company is building in conjunction with the English Electric Company, Ltd., for the Spanish National Railways. These locomotives are the largest electric locomotives to be built in this country and one which was described in our issue of May 2, 1952, is illustrated on Plate 2.

The locomotives are C_o–C_o units, with each of the six axles driven through spur gears by a nose-suspended motor having a one-hour rating of 600 h.p. and a continuous rating of 500 h.p. With the locomotive weight of 118 tons in working order, this motor arrangement gives a maximum starting tractive effort (25 per cent adhesion) of 67,000 lb. The one-hour tractive effort is 39,000 lb at 34 m.p.h. and the continuous tractive effort is 30,500 lb at 36 m.p.h., the maximum permissible speed being 68·3 m.p.h. The main dimensions of the locomotive are: gauge 5ft 6in, maximum width 10ft 1in, length over buffers 67ft 9in, total wheel base 50ft 7in, rigid wheel base (bogie) 15ft 9in, wheel diameter 48in, overall height (pantograph down) 14ft 6in, minimum curve negotiable 525ft.

The first diesel-electric locomotives to be built by the newly formed company, Brush-Bagnall Traction, Ltd., were delivered in 1952 from the shops at the Loughborough works of the Brush Electrical Engineering Company, Ltd. These locomotives were part of the order for twenty-five 1000 h.p. diesel-electric units being built to the order of the Ceylon Government Railways, and they were described and illustrated in our issue of November 28th last.

The new "A1A–A1A" locomotives have a weight of 87 tons each and are designed for a maximum speed of 55 m.p.h., the tractive effort at the one-hour rating being 30,000 lb at 9·2 m.p.h., and the continuous tractive effort 24,600 lb at 11·7 m.p.h. They have twelve-cylinder vee, turbo-charged, Mirrlees, Bickerton and Day engines, which develop 1254 b.h.p. at 850 r.p.m. In each locomotive the engine is directly coupled to a main generator with a continuous rating of 625kW, 630V, 1035A, which provides power to four traction motors—one on each of the two outer axles of each bogie—with a continuous rating of 196 h.p. These locomotives are arranged for multi-unit operation, in which case they are coupled electrically as well as mechanically, so that they are controlled by a driver in the front cab of the leading locomotive.

We are informed by the General Electric Company, Ltd., that it is supplying all of the electrical equipment for an order for forty 3000V electric locomotives placed with the North British Locomotive Company, Ltd., by the South African Railways and Harbours Administration. This contract is now partly completed and a number of the locomotives are in regular service. These locomotives, which weigh 155 tons in working order, are said to be the largest yet built for 3ft 6in gauge track, and one of them is illustrated on this page.

The locomotives are carried on two six-wheeled bogies each having a leading pony truck. One traction motor drives each of the six driving axles, the six motors giving a one hour rating of 3030 h.p.

The locomotives were ordered in connection with the electrification of the main line from Capetown to Beaufort West, a distance of about 330 miles, and their duties include the hauling of 610-ton passenger trains up a gradient of 1 in 50 and goods trains of 1070 tons up a 1 in 66 gradient. Regenerative braking is incorporated.

At the works of the British Thomson-Houston Company, Ltd., work was continued on ten 1000 h.p. diesel-electric locomotives for the New South Wales Government Railways, and eighteen 400 h.p. diesel-electric shunters for the Western Australian Government Railways. Each of the N.S.W. locomotives comprises two independent engine generator sets, which are housed in bonnet enclosures in front and behind a central cab with two alternative driving positions. The driver's controller incorporates a handle for power control and another for forward or reverse travel. The pneumatic power contactors and reverser and all auxiliary contactors, relays and resistors are arranged in a self-contained framework mounted adjacent to the cab in one of the bonnet enclosures.

Development Areas Advisory Committee.—The Treasury announces that Mr. W. B. Beard has been appointed a member of the Development Areas Treasury Advisory Committee in succession to Mr. T. Williamson, who has resigned owing to pressure of other business. Mr. Beard is the general secretary of the United Pattern-makers' Association and a member of the general council of the T.U.C.

The Royal Navy, 1952

(By our Naval Correspondent)

No. I

Rearmament

TWO years of rearmament have increased the fighting formations of the Western nations immediately available in Europe from seven divisions—all under strength and ill-equipped—to twenty-six divisions equipped with modern weapons and transport, under unified command and capable of operating as one army. The Soviet Army would no longer find it possible to overrun Western Europe by a sudden attack delivered without warning by the thirty Russian divisions maintained at full strength and ready for immediate action in Eastern Germany and Poland. It was this menace which the British nation had very much in mind when, in January, 1951, they willingly accepted an expenditure of £4700 million on rearmament during the following three years. They accepted it not from philanthropic motives but for self-protection, for airborne divisions, guided rockets and atom bombs launched from enemy occupied ports across the Channel and North Sea would test to the utmost this country's ability to endure. While, however, the military position in Europe has improved, the Western nations have still a long way to go to ensure the safety of their sea communications. Naval expansion is a long-term affair and in spite of the lesson of the last war—when twenty-six ocean-going U-boats sank 471 merchant ships, totalling over 2 million tons, during the first fourteen months—Britain did not begin building an effective anti-submarine and minesweeping force until the Korean war.

H.M.S. " Eagle " British Fleet Aircraft Carrier

The rearmament programme provides for the building or conversion of a substantial number of vessels for anti-submarine and anti-mine operations and patrol duties ; but it was a very late beginning and, apart from three or four anti-submarine frigates converted from destroyers, none of these ships has as yet been completed. In the initial stages of naval rearmament, efforts were concentrated on completing designs and placing orders, but during the past twelve months considerable progress has been made both in the building of new vessels and towards the completion of the aircraft carriers and destroyers laid down during the war. The fleet carrier " Eagle " illustrated herewith and in Plate 3 is already in commission and seven of the eight " Daring " class destroyers, see Plate 3, should be completed by the end of March this year. The Royal Dockyards, which were already busy refitting and modernising ships, are now being used to the limit of the labour force available and private industry is having to undertake a substantial portion of the work, in spite of the shipbuilding and engineering firms having very full order books of merchant ship building. At the beginning of 1952 contracts had been made for over 1000 merchant ships, totalling some 6¼ million tons gross. High priority is, however, being given to anti-submarine and mine-sweeping vessels and there are fortunately still several smaller shipyards, which do not normally engage in naval work, anxious to book orders for mine sweepers and other small craft. A number of the sixty-five new type coastal and inshore minesweeping vessels are being built by these firms. The main difficulty is the shortage of steel, timber and other essential raw materials—which is partly due to the higher priority now being given to exports—and this will almost certainly delay the completion of the larger vessels beyond 1955. It has already been necessary to cancel the order for a new 10,000-ton hospital ship. Shortage of manpower is another serious problem. The Navy's share of the labour force required in the shipbuilding and ship repairing industry has now risen to about 30 per cent and in spite of the schemes for upgrading and training which the industry is being encouraged to develop, it is not easy to see how all these men are to be obtained.

Future Naval Building Policy

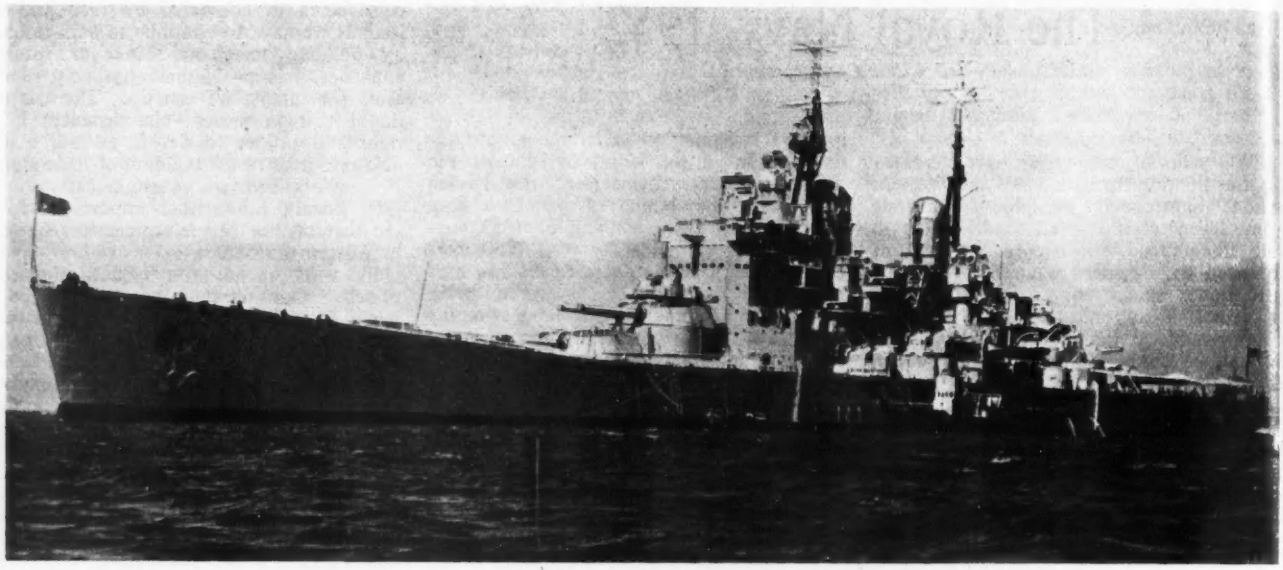
Apart from hastening the completion of the aircraft carriers and destroyers laid down during the war, the naval building programme is purely defensive—to safeguard our sea communications and harbours from submarine attack and mines. Some 200 small ships—anti-submarine vessels, mine sweepers and patrol craft—are to be constructed or converted by 1955 and as long as we have to continue to earn dollars by building merchant ships for foreign countries, this programme probably represents the utmost we can do. There is no doubt that in present circumstances it is right and proper to devote all our available resources to the building of these ships. For unless our sea communications are safe, Britain can neither import the food she requires nor can reinforcements be sent to Western Europe.

But wars are not won by anti-submarine vessels. Our ultimate goal should be a Navy able to take the offensive in war and to ensure that in time of peace this country once again plays an effective role in world affairs. Under modern conditions there is no enemy surface fleet to bring to battle and destroy. Offensive operations nowadays mean the landing of expeditionary forces to invade and capture strategic areas and the bombing of inland communications and war potential establishments. This requires Task Forces, each comprising a substantial number of carriers and cruisers, with destroyers and anti-submarine vessels to escort them, and during the present emergency the vast majority of these vessels will require to be provided by the United States. With the completion of the rearmament programme in 1955 we shall still have only eleven carriers with the necessary speed and performance to operate in enemy waters against shore-based aircraft. Even this small number depends on the modernisation of the " Illustrious " class—a modernisation which may be impracticable if it is decided to build more of the smaller carriers for anti-submarine operations. The cruiser position is still worse, for we have now only twenty-four of these ships for Task Forces and for guarding the many focal areas of trade against attack by enemy cruisers or, more probably, by armed raiders disguised as peaceful merchant vessels. We cannot indefinitely rely for our safety on the United States. Nor would it be safe to do so. If the United States has replaced Britain as the greatest and most powerful nation in the world, this does not mean that she will always be willing to come to our assistance or to intervene in European quarrels when Communism has been checked. Clearly, when the present emergency is over and the French and other European armies are re-equipped and again up to their pre-war strength, we must abandon conscription and large armies and concentrate on rebuilding the sea power which made us a great nation.

H.M. Ships—Numbers and Types

Battleships.—Before carrying out offensive operations in enemy waters on a large scale, it is necessary to deal with the enemy's surface warships. They must either be destroyed or contained in harbour. And as Russia has no modern battleship—a synonym for the strongest ship, offensively and defensively, it is practicable to build—the Government has been criticised, both in and out of Parliament, for not scrapping our five modern battleships after the war. Four of them are laid up in " mothball reserve " in the Clyde, requiring only a few caretakers to look after them. With their gun mountings, machinery, and all working parts enclosed in air-tight plastic covers, they remain in first-rate condition and could be brought forward for service when required at short notice.

The fifth ship, the " Vanguard," (page 6) has been left in commission and has been acting as Flagship of the Home Fleet. To criticise the retention of these ships is to overlook the



H.M. Battleship " Vanguard "

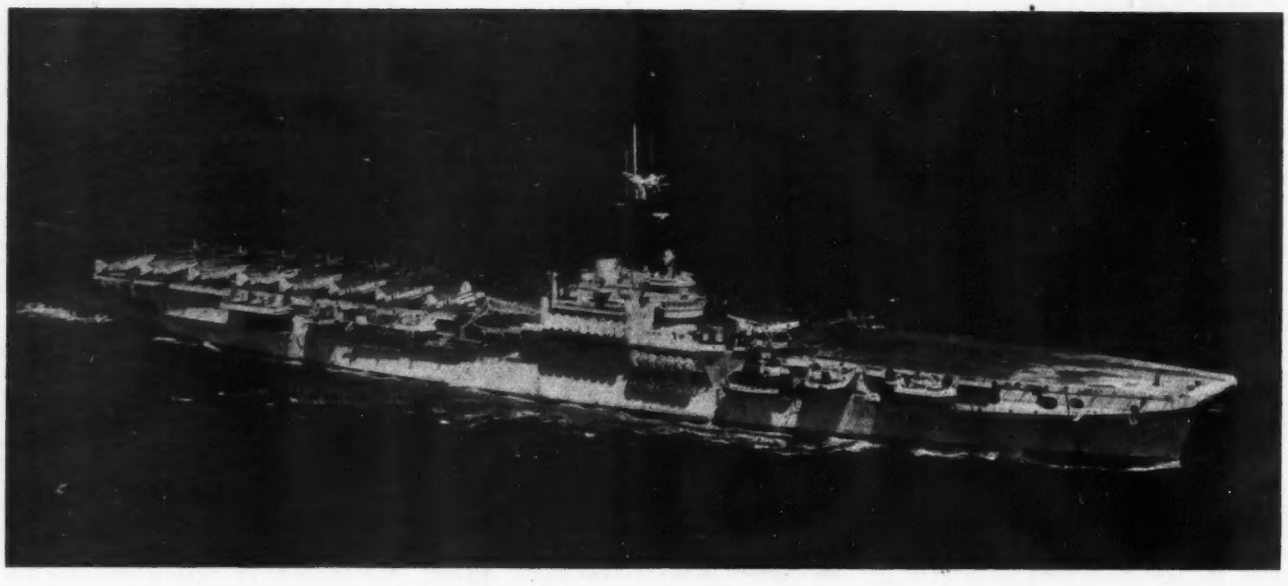
invaluable support battleships were able to provide, with their powerful and concentrated anti-aircraft armament, for the United States carriers in the Pacific when carrying out offensive operations in the Japanese war. They might well be required again to operate with Task Forces carrying out offensive operations in the future. Moreover, the Russians could build similar ships within a period of three years, though there is no reason for believing reports from foreign sources that they are building three 35,000-ton battleships at the present time.

The development of the guided missile and the application of the atomic charge to tactical weapons may, in due course, result in the construction of a still more powerful ship—a vessel equipped with guided rocket launching platforms, but smaller, faster and more expendable than the battleship as we know her to-day. In any event, it seems reasonable to assume that the trend in new construction will be towards reduction in the size of ships, as it was after the first world war, when, under the Washington Treaty, the size of capital ships was limited to 35,000 tons. But until the day comes when guided missile platforms replace flight decks, it is essential to retain the battleships we have.

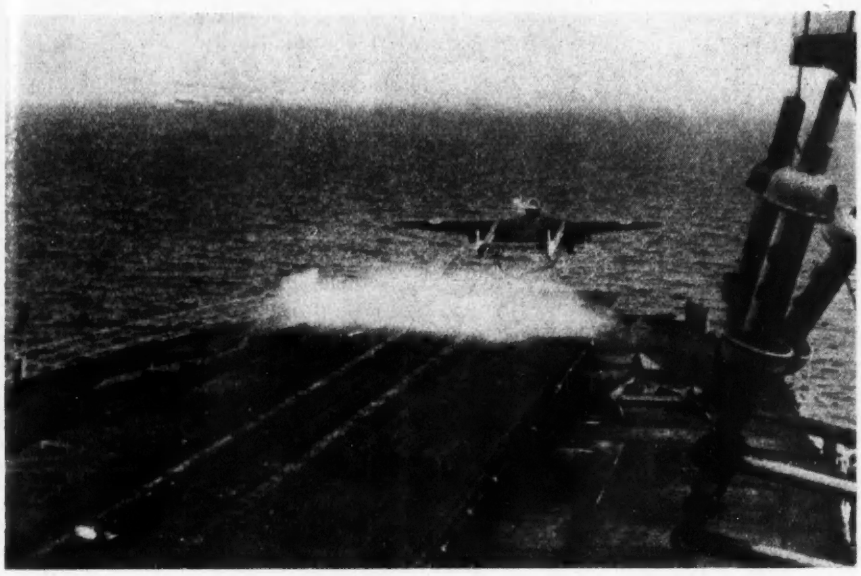
Fleet Aircraft Carriers.—Originally designed to provide aircraft for finding the enemy battle fleet and reducing its speed by torpedo bomber attack, the fleet carrier now represents the striking power of a navy, and is intended for offensive operations in enemy waters. Each new ship of this kind is larger than her predecessor, to keep pace with the ever-increasing weight, size and speed of the aircraft they will be required to operate if these are to compete with shore-based aircraft on equal terms. The " Eagle," which joined the fleet last year has a designed tonnage of 36,800 tons and the United States Navy is now building a carrier of 60,000 tons. The U.S. Navy hopes to lay down another of these giant carriers each year for the next nine years, and Congress has already approved a second carrier.

The primary task of the fleet carrier under modern conditions is to take part in the kind of offensive which is always open to the belligerent holding command of the sea—invasion and capture of vital areas on the enemy's coasts. For carriers alone can provide the necessary aircraft during landing operations, and while the N.A.T.O. Air Forces are establishing air bases ashore. The size of the United States carriers indeed, indicates that they will carry bombers of considerable range and represents a triumph for the naval view. United States naval officers have consistently maintained that the bombing of hostile inland communications, submarine harbours and war potential establishments can be best carried out by medium range bombers, with fighter protection, operating from carriers off an enemy's coast. In any event, the fleet carrier is an essential requirement to-day and her disadvantages—absence of docking facilities in likely operational areas, large number of "eggs in one basket," &c.—must be accepted.

With the "Eagle" and the " Ark Royal " —to be completed in 1954—the Royal Navy will have seven fleet carriers including five ships which were completed during the war. The " Implacable " and " Indefatigable " are of slightly later design and faster than the remainder (" Illustrious " class), but all will require strengthening and extensive modernisation to enable them to operate the latest types of medium range bombers. One of them—the " Victorious "—was taken in hand



British Light Fleet Aircraft Carrier " Glory "



Launching a "Vampire" from the Steam-Operated Catapult During Trials in H.M.S. "Perseus"

two years ago. The sixth carrier of the class—the "Formidable"—was scrapped last year. There are also four smaller but almost as fast carriers of the "Hermes" class, which are being completed under the rearmament programme, and will be fitted with all the latest installations. These ships were laid down during the war as a larger and faster type of light fleet carrier. But their decks have been strengthened while under construction, and with their fast speed they should be quite effective for offensive work overseas. Casualties are likely to be heavy, however, and a total of eleven carriers for these operations would be entirely inadequate were it not for the twenty-seven available in the United States Navy.

Light Fleet Aircraft Carriers.—Apart from the light fleet carriers lent or transferred to the Dominion and Western European Navies—the "Vengeance" was lent to the Royal Australian Navy last year, pending the completion of the "Majestic" of the same class, now building at Vickers-Armstrongs, and to be named H.M.A.S. "Melbourne" on completion—Britain's post war fleet includes five light fleet carriers of the "Majestic" or "Glory" class (page 6). They were laid down during the war at a time when there had to be rigid economy in naval building and were regarded as make-shift vessels intended to meet the immediate requirements of the Japanese war. The construction of three more ships of this class—"Hercules," "Powerful" and "Leviathan"—was suspended a year after the war, but the "Powerful," laid down at Harland and Wolff's yard at Belfast, has now been sold to Canada to replace the "Magnificent," at present on loan to the Royal Canadian Navy. She is to be strengthened and modernised and will be capable of handling jet aircraft. Carriers of this class, which have a designed tonnage of some 13,000 tons, are not large enough nor strong enough to operate medium range jet bombers during offensive operations overseas. They are, however, very suitable for general reconnaissance work and anti-submarine operations.

"Dragonfly" Helicopter Landing on H.M. Cruiser "Belfast" in Korean Waters

Modern anti-submarine aircraft are much heavier than their predecessors as a result of the increased weight and size of detecting devices and weapons and the problem of catapulting them—nowadays the normal method of launching aircraft from a carrier—from the conventional hydro-pneumatic catapult had become insoluble. Fortunately, the newly invented British steam-operated catapult, which takes up relatively little space, can operate the heaviest carrier-based aircraft as illustrated here. The increased thrust required when catapulting the heavy modern jet aircraft automatically increases the risk of overstraining both the structural tolerance of the plane and the physical endurance of the pilot, but in spite of the greater acceleration of the new catapult, the compressibility of steam provides a smoother and steadier build-up than does the conventional catapult. A further advantage is that the steam catapult is capable of launching jet fighters when the carrier is heading off-wind—under certain conditions it can even launch aircraft with the ship at rest. Finally, the improved arrester gear now available has overcome the difficulty of landing high-speed jet aircraft.

Carriers for Convoy Escort Work.—During World War II when German submarines extended their area of operations to the middle of the Atlantic, the problem of providing the large numbers of escort carriers required to give aircraft cover to convoys throughout their voyage was solved by the conversion of merchant ships of about 9000 tons displacement and a speed of 16 knots. Similar, or possibly somewhat larger, merchant ships are likely again to be used as convoy escort carriers in a future war, as the result of the invention of the steam catapult and improved arrester gear. They need only have their decks strengthened and suitable lifts installed.

Another encouraging development is the use of the helicopter as an anti-submarine patrol aircraft. Trials with a Westland-Sikorsky "Dragonfly," operating from a small platform built on the stern of a merchant ship, as illustrated here, have given excellent results. The improved "Dragonfly"—used commercially either as ten-twelve-seater passenger craft or for carrying cargo and known as the "S 55"—has a useful load of 1 ton, a range of some 460 miles and a cruising speed of about 85 miles an hour. She would no doubt be unable to carry some of the necessary heavy anti-submarine equipment but she could at least be employed to keep submarines submerged and prevent them following and shadowing a convoy. Much larger and stronger helicopters are, however, now in project and, as the helicopter lands on by "floating" down gradually, there should be no difficulty in giving the required extra strength to the after part of the deck and to the superimposed platform in a medium-sized merchant ship.

(*To be continued*)

RESEARCH IN CORROSION.—A note from the Department of Scientific and Industrial Research states that information obtained from examination of iron implements 2000 years old may lead to a new method of protecting underground pipes from corrosion. Although the articles were buried in one of the most aggressive soils possible, they were found to be perfectly preserved. Tannates in the soil appeared to have completely prevented action by sulphate-reducing bacteria, which are responsible for most cases of rapid corrosion in waterlogged clay soils. The iron articles, ranging from hobnails to knives, were found during excavations at Hungate, York, on a waterlogged site, where they would normally corrode in a very short time. Because of their excellent state of preservation, samples of the soil in which they had been buried were examined by the Chemical Research Laboratory, D.S.I.R. Sulphate-reducing bacteria were found to be present, but not active, though the soil would ordinarily have been highly aggressive towards iron. As a result of investigations it was decided that the tannin deposits in the soil from leather cuttings and old shoes had protected the iron. Later work has shown that tannic acid in greater concentration than 0·01 per cent stopped the action of sulphate-reducing bacteria. The discovery, it is said, may result in a method of protecting water and gas pipes, for example, from corrosion.

Labour in 1952

By GERTRUDE WILLIAMS

No. I

DURING the four months of spring and early summer last year the percentage of unemployed persons wavered between 2 and 2·2 per cent of the insured population. Had such figures been recorded in the twenty years between the two wars they would have been hailed as showing the advent of the millenium and most people would have felt that our economic troubles were over. For, during those two decades, unemployment twice rose to over 22 per cent and only once, and for a short time, fell below 10 per cent. It is evidence of the profound changes that have taken place in our social assumptions and expectations and of the great differences between our pre-war and our post-war economy that an unemployment figure of 2 per cent should have caused such consternation. Had the larger number of unemployed been spread over all industries and throughout the whole country, their existence might not have given rise to such feelings of anxiety; but they were concentrated mainly in one industry—the textile—and consequently in one region, the North-West. As the cotton industry relies predominantly on women's labour, the most severe unemployment was found amongst a group of workers who, for domestic reasons, found peculiar difficulty in transferring to other occupations, with the result that the female rate of unemployment in that area rose as high as 8 per cent and still remains over 5 per cent.

This is only one of a number of indications that have induced a general feeling of uneasiness, and even despondency, in the whole field of labour. The constant fight to halt the rise in prices and to maintain national solvency, the appreciable drop in the rate of industrial production and the decrease in the volume of imports and exports, have been constant and nagging reminders of the difficulties that have to be faced and surmounted before the brave New World, that was so confidently expected at the end of the war, can come within nodding distance. It is against this background that the events of the year must be discussed, for anxiety about the future has led to stronger resistance to wage increases than has been seen for many years.

Cost of Living

So many wage claims during the year have been based on the rise in the cost of living that something must first be said about the change in the method of calculating this figure. There are few figures to which more constant reference is made by the " man in the street " and still fewer which are more densely shrouded in the mists of incomprehension. The trouble about money is that, unlike other units of measurement, it won't stay put. A yard is the same length, come wet or fine, war or peace, just as an acre is always the same area of land and a ton the same weight. But money has no standard value in this unvarying sense; it is worth just what it will buy, and as the things available for sale change—some becoming more accessible and others the reverse—so the value of money changes too. All that the retail price index tries to do is to measure changes in this value or, to put the same thing the opposite way round, to show what changes have taken place in the general level of prices (i.e. not in the price of this or that commodity, but of prices as a whole) and, in particular, the prices which affect the mass of the population whose incomes fall in the lower ranges—roughly those getting less than £500 a year.

If we all spent our incomes on the same articles and there were not a wide variety of them, it would be easy enough to measure these changes in the value of money. Suppose, for example, we all spent half our money on bread and the other half on butter, there would be no difficulty in calculating the effect on the worth of anybody's income of a rise or a fall in the prices of these two commodities. But, of course, life is not as simple as that. Not only do we buy literally hundreds of separate articles and personal services in the course of a few months, but also we spend different proportions of our incomes on them. These differences are due to the total amount we have to spend, the number of dependants we have to provide for, the kind of people we live amongst and our individual tastes. The pattern of expenditure—that is, the proportions of income we spend on various kinds of food and drink, on clothes and household equipment, on holidays and fuel, &c.—is quite different if one has £5000 a year from what it is if one has £500 and quite different again for the bachelor and for the man with a wife and family. That is fairly obvious. What is not quite so obvious is that it varies also according to one's social environment and personal tastes. Though the skilled coalgetter and the headmaster of a school get somewhere about the same annual income, their patterns of expenditure are likely to be widely different; and, in the same way, of two headmasters earning the same amount, the non-smoker is unconcerned when the price of tobacco goes up, whilst his colleague, who cannot think without a pipe in his mouth, feels definitely poorer.

The only practicable way, therefore, in which we can measure the effect of changes in prices on the value of our incomes is to take a " typical " income and a " typical " pattern of expenditure. But what is, in fact, " typical " ? Before the war, 90 per cent of people had incomes below £250 a year (and prices, of course, were much lower), so it was reasonable to assume that an investigation into the way in which the average person with less than £250 a year actually laid out his income would give a sensible basis of measurement. If, for example, such an inquiry showed that the average household spent a third of its income on food and a ninth on clothes, then any change in the prices of foods would " matter " three times as much as changes in the prices of clothing and could be weighted accordingly.

Cost-of-Living Indices

Such an investigation was, in fact, made just before the war and was used as the basis of the interim retail price index, which was introduced in June, 1947—that is, as soon as possible after the end of the war. From that date, the price index showed each month how much money would have had to be spent in order to buy the same " bundle " of goods and services, as could have been bought for £100 in June, 1947, assuming that the proportions of income spent on different kinds of things were the same as the inquiry had showed them to be just before the war.

Since then, there has been constant criticism of these assumptions. The fourteen years since the inquiry was completed have seen profound changes in ways of living, due, in part, to the maintenance of full employment and higher earnings, partly to the redistribution of wealth as a consequence of social legislation and progressive taxation and partly to the emergence of new tastes and opportunities (such as television, for example). In June, 1951, therefore, the Cost-of-Living Advisory Committee—a body which advises the Minister of Labour and which consists of representatives of the British Employers Confederation, the General Council of the Trades Union Congress, the Co-operative Movement, the Retail Distributive Trades Conference and the National Federation of Women's Institutes, together with independent statisticians and representatives of various Government Departments—recommended that a new full-scale budget inquiry should be undertaken to provide up-to-date information on which to base a new index. This recommendation was accepted and preparations for such an inquiry are now being made.

Meanwhile, the committee considered whether any changes should be introduced as a temporary measure. There has, for example, been an understatement of the real increase in the level of rents, due to the exclusion of dwellings which have come into occupation since 1947, for many of which rents are relatively high. On the other hand, changes in post-war patterns of consumption have meant that certain other articles have been over-estimated; so that, on balance, the committee believes that the index had, in fact, given a pretty fair indication of the general effect of price changes. But it could not be assumed that this would continue to be the case in the future, and they therefore recommended certain modifications, which included a few alterations in the list of items for which prices are obtained and a change in the procedure for calculating movements in rents and rates so that the effect of higher rents of houses and flats, erected since 1947, might be taken into account.

Since February of last year, these modifications have been introduced. The index is now calculated on the basis of the pattern of consumption that it is estimated was current in 1950, valued at prices actually ruling in January, 1952. Since that month, two calculations have been made each month—the first shows a comparison between the current prices and the prices ruling last January; the second links these changes to the Index that has been compiled since 1947 so as to preserve continuity. The figures given in the November issue of the *Ministry of Labour Gazette*, for example, showed that the price index as a whole had risen 38 per cent in comparison with June, 1947, and 3·9 per cent in comparison with January, 1952.

But this second general figure concealed differences of some importance, for, whilst clothing prices had actually fallen by 4·5 per cent, food and transport had both gone up by over 8 per cent. When one is hard pressed one can, however unwillingly, cut down expenditure on clothing, but it is very much more difficult to reduce one's purchases of food or to alter the cost of getting to and from one's work. It is not a matter for surprise, therefore, that, as prices rose, the year has seen a continual series of demands for wage increases based on the difficulty of making ends meet.

The Meaning of the Index

Unfortunately, however, most references to the index made during such claims show very little understanding of what the index

really is—that is, simply a measure of changes in the money cost of the actual pattern of consumption that was in existence at a certain time. It implies no judgment as to whether that particular pattern represents a standard of living which is right and proper in itself and which must be maintained intact, though many wage claims have been based on the assumption that it does and that every rise must be reflected in a similar rise in wage rates. But even more important, it does not (and, indeed, could not) take into account any of the constituents in the standard of living which are not paid for by the individual consumer. It is this second category which has grown so greatly in importance during recent years. The National Health Service, extended educational facilities, improved retirement and other social insurance benefits, an accelerated housing programme of dwellings let at uneconomic rents, food subsidies and other similar civic amenities, add a large, though indeterminate, amount to the standard of living of almost every family. But they all have to be paid for and, in the last full year for which figures are available (1950–1) their total cost was £1521 million—an amount of money which was almost twice the total Budget of pre-war years. Every increase in the cost of these services—as, indeed, every increase in other national commitments, such as defence—necessitates a rise in taxes, whether this be an increase in income tax and surtax or an addition to indirect taxes and purchase tax. Now, whilst every rise in indirect taxes is faithfully reflected in consumption prices, and this shows in a higher price index, no compensating assessment is made of the benefits which are enjoyed collectively and which tend to be ignored in measuring the total effect on the standard of living. Indeed, it could not be otherwise, for whilst the higher prices we have to pay are only too painfully apparent to every individual, the corresponding benefit he draws varies from time to time according to his circumstances, and could only be assessed in money terms after prolonged and delicate calculations.

Taxes and Benefits

The great change that has come over the form of our incomes, as a result of the extension of social activity, is only just beginning to be understood. Every person in the community is now continually paying part of his income into the national funds in the form of taxes and insurance contributions and continually taking out part of his income in the form of collectively provided benefits. A household with young children takes out family allowances, food subsidies, health services, education and school meals and, possibly, a house at less than its economic rental value, and pays in the form of P.A.Y.E., taxes on entertainments, drink and tobacco and purchase tax on many of the articles it uses. Almost certainly at that point it gets more than it gives; that, at least, is the intention of the social legislation. But as time goes on and the children grow up and many of these benefits can no longer be claimed, the position is reversed and the same household, with the head earning the same wages as before, now pays out in taxes more than is received in benefits, until he reaches pensionable age and the balance shifts again. Naturally enough, however, we judge of any alteration in either benefits or taxes as it affects us at the moment and do not calculate what the long-term balance would be over the whole of our lives. From the purely fiscal point of view we could now abolish all food subsidies and all purchase tax, for, in the last financial year, the two were about the same, the reduced subsidies costing about £300 million and purchase tax bringing in £330 million. But, unfortunately, it is not the same people who would be affected in both cases. Higher food prices, if subsidies were given up, would hit the poorer families hardest, and the more young children to be fed, the harder they would be hit. The relief of lower prices, resulting from the removal of purchase tax, would not benefit these poor families, who could not afford to buy the furniture, and electrical equipment and clothing and other "less essential" goods on which purchase tax is now specially high. Probably a large proportion of wage earners with reasonably good earnings would not, on balance, be seriously affected one way or the other; but some families, and those least able to bear it, would suffer greatly, whilst another group, the better off, with few young children, would gain appreciably.

It was this complex relationship between taxes and benefits that led to so much angry controversy when the Chancellor of the Exchequer reduced food subsidies in the last Budget and claimed that he had compensated for the higher prices of food by income tax concessions. As the spate of wage claimants pointed out, the poorer households that fell below the income tax limits could not receive any advantage from these concessions, but were immediately hit by the increased cost of food. And it was, therefore, particularly unfortunate that the first official action relating to wages during this controversy was that of the Minister of Labour in referring back, for further consideration, the proposed rates of minimum remuneration that had been sent to him by several wages councils.

Wages councils operate in those industries and trades in which the degree of organisation of the workers is too slight to afford any effective machinery for voluntary negotiation on wages and hours and in which, in consequence, wages are thought to be lower than could be reasonably expected. Each wages council, which is set up only after a thorough investigation by an independent Commission of Inquiry, is composed of three groups, all of whom are nominated by the Minister but who are intended to speak for different interests. One group represents the employers, one the workers and the third consists of three "independent members," one of whom is chairman, who represent, so to speak, the interest of the community. Great care is taken by the Minister of Labour to ensure that every sectional interest on both sides has adequate representation so that all points of view may be taken into account. The ideal situation is for the two representative sides to reach agreement and, indeed, this is very usual on many of the councils; but, if such agreement proves impossible, the independent members have the deciding voice. The decision of the council is then published so as to allow objections to be raised, and after these have been considered the council refers its proposals to the Minister, on whose confirmation they become the minimum rates of remuneration legally permissible in that occupation. The Minister has no power to alter the proposals in any way; he must either confirm them or refer them back to the council for further consideration.

It can be assumed, therefore, that any wages council's proposals have had very thorough discussion before they reach the stage of reference to the Minister—thorough discussion not only by all sections of the interested parties, but also by the independent members, who can be expected to take care that the public interest is not lost sight of. Such discussions, necessitating, as they do, the bringing together of many people from all over the country, take time, and thus it usually happens that a proposal does not finally become law until, perhaps, a year after the original application for a change in rates has been made.

Last year it happened that a number of proposals made by various sections of the distributive trades were referred to the Minister at the very time that the Chancellor of the Exchequer had appealed to the Trades Union Congress to urge a policy of severe wage restraint on its affiliated unions and had pointed out, in support of this plea, that the increased food prices from reduced food subsidies were already compensated by income tax concessions. Sir Walter Monckton thereupon referred back all these proposals on the ground that the councils had not had an opportunity to take into account the Chancellor's letter—an action which was well within his constitutional rights, but which was certainly ill-advised—both because wages councils deal only with the minimum rates of less well-paid workers, who stand to lose by the higher prices without gaining anything from the concessions, and because the composition of the councils already makes provision for public policy to be considered during the negotiations before any proposal is made. In this case the Minister's action simply caused a little more delay without altering the final upshot. Each wages council was recalled to give further consideration in the light of the Chancellor's plea; each came to the same decision as before and referred the proposals, unchanged, to the Minister, who then confirmed them.

The increases granted to the distributive trades varied from 6s. to 10s. a week, and this is a fair sample of advances during the year in other industries, whether reached by voluntary agreement or as the result of arbitration. Agriculture, road haulage, railway workers, bus employees, electricity, and gas workers have all gained something near to this figure, an amount which compensates fairly well for the rise in food prices of those living in the lower income ranges, but is far below the rise in the cost of living in the better-paid groups, where, however, income tax concessions have more influence in redressing the balance.

Wages Claims

The stiffening resistance to wage increases has been particularly evident in the unsuccessful struggle of the engineering and shipbuilding employees and the mine workers during the second half of the year. In the case of the engineers and shipbuilders the first of whom had claimed a rise of £2 a week, and the second, a "substantial amount," it looked for a time as if there might be a serious stoppage; the employers stubbornly refused to make any counter proposals, on the ground that they were in danger of being priced out of export markets altogether, and the unions threatened to put a ban on all piece and overtime work, a course of action which might mean a loss of £4 or £5 a week to a skilled worker. Only after prolonged negotiations, assisted by the chief industrial commissioner of the Ministry of Labour, did a more reasonable spirit prevail. The engineering employers offered a rise of 7s. 4d., the shipbuilders 7s. 6d., and the unions, bitterly disappointed as they were, showed a great sense of responsibility and restraint in persuading their members to accept.

The miners, who had claimed an increase of 30s. a week, had an even bitterer pill to swallow; for the National Reference Tribunal, whose decision both sides are bound to accept, refused any increase at all. It

argued that the miners, whose average weekly earnings had risen 62 per cent since 1947, whilst the cost-of-living index had then risen only 38 per cent, had been over-compensated for the rise in prices in the last increase they had received in November, 1951, and that it was wrong to expect wages to be governed by every minor change in the price index. Whilst it recognised that there might be some case for improving the conditions of the lowest-paid workers, it opposed any interference with existing wage agreements whilst the whole wages structure of the industry was under review, as it is at present. It is likely that this review will take some time, however, for there are over 6000 recognised categories of jobs, the majority of which have more historical than actual significance. The colossal task of reducing these to a more manageable number—twenty-two has been mentioned as the aim—will put a considerable strain on the forbearance and patience of those concerned. Any increase to special groups whilst this is going on must almost inevitably add to the difficulties of reaching agreement in the new structure, and it is to the credit of the miners that they have accepted the unpalatable necessity of facing this reality with a minimum of protest.

Unusual Disputes

Two unusual disputes took place last year, of a kind which might become more common if unemployment should grow more serious : one at the Smith Clock Company at Cricklewood and the other at the Ford works at Dagenham. In the first case the workers were informed that the management found themselves forced to dismiss about 200 employees on account of the cancellation of very large orders from Australia. One of the factories was being retooled to deal with orders for another market, but it would be some months before work was available. At Fords, the difficulty was caused by a lack of components, due to an unofficial strike at a subsidiary. In both cases the workers claimed the right to be retained on the establishment and paid full wages, whether there was any work for them to do or not.

This kind of dispute, which is a fairly new phenomenon, has some very difficult features. Very short-term employment is as bad for the firm as it is for the worker, and it can generally be expected that a body of workers should be tided over temporary breaks in the continuity of production. Indeed, in industries where labour is hard to come by, many firms hoard workers during slack periods, despite the burden on their own costs and the difficulties in which they put employers who might have been able to offer alternative employment, so as to be certain of staffs when they wish to swing into full production again. But, obviously, there is a limit to what can be afforded and even a very rich firm cannot stand the expense of paying a large proportion of its labour force full wages when there is no output to offset these costs.

The interesting thing is that in both these disputes the workers claimed permanent employment as a right, though it is certain that they did not realise the implications of such a demand. During the bad times between the two wars there were many who insisted that workers should be regarded as members of an " industrial army " with a right to full pay whatever the circumstances, and much play was made with the fact that soldiers receive the remuneration due to their rank whether there is a war on or not. What was always forgotten, in these arguments, was that soldiers are under military orders and must go where they are ordered and do what they are told. No civilian worker is prepared to have such a restriction on his liberty.

In recent years, whilst the claim has not often been put forward so blatantly as in these two disputes, it has been implicit in many of the criticisms of methods of coping with redundancy. There is no doubt that there is considerable confusion in people's minds about the meaning of full employment, the maintenance of which is now recognised by all parties as an essential constituent of a reasonably happy and efficient community. The Government's acceptance of the responsibility for ensuring that the productive resources of the community are fully utilised does not, of course, guarantee to every individual the right to hold a particular job for the whole of his working life, whether that kind of work is needed or not. Indeed, how could it ? The prime essential of a dynamic economy is flexibility and adaptability, and unless men and women are prepared to leave occupations where their work is no longer needed to undertake the new jobs required by changing techniques and changing demands, there is no possibility of gaining any advantage in higher standards of living from the advance of knowledge. But to most individuals full employment does mean the right to stay where they are, doing the accustomed job, at the accustomed wage.

As long as the demand for labour in practically all industries remained as pressing as it has been in the post-war period, this confusion of thought has been concealed, but it is likely to be sharply revealed as one trade after another is faced with greater difficulty in finding eager buyers for its goods. Already the question has become acute in the dock industry, where there are added complications to increase the difficulty of finding a reasonable and humane solution to the problem.

Dock Labour

For sixty years before the beginning of the recent war, the methods of engaging labour in the docks had been a constant source of unhappiness and controversy. In most industries, men who are taken on know they will probably keep the job as long as there is work to be done and they are doing it with reasonable competence. In the docks there was no such assurance. The most that had been obtained was that men taken on at all would be employed for a half-day shift, but there was no guarantee of anything further. This casual method of staffing seems mad until one remembers the essential characteristics of the industry. The volume of work to be done is almost entirely outside the control of the dock employer ; it depends on the quantity of imports and exports, the weather and the tides. A strike in a foreign port might hold up ships for a day or a week so that the expected cargo was not there to be unloaded, or a fog might delay a ship long enough for one shift of work to be wasted. If dock work required skilled men it would still have been necessary to have a regular labour force ready to be turned on to the work when it actually arrived. But, in fact, the majority of the jobs need nothing more than the normal strength and endurance of the average man accustomed to fairly heavy physical work. Employers could, therefore, usually be fairly certain that there would be sufficient men available whenever there was need for them without retaining them as a permanent force. Twice a day as many as were needed were taken on for the half-day shift and there was no guarantee that the man employed in the morning would get taken on again in the afternoon, though the job was still unfinished. What added enormously to the problem was the fact that a port is not a single employing authority, but is made up of hundreds of separate firms of very varying sizes, each of which tended to create its own pool of labour, and there was no way of ensuring that men who were unsuccessful at their usual stand could discover where else in the port there was a shortage that might give them a chance to earn.

The results of this system were almost wholly bad. There were always many more men attached to a port than could ever hope to be employed even if all the employers were exceptionally busy at the same time. There was, consequently, chronic under-employment and earnings were so irregular that dockers' families had neither inducement nor opportunity to budget on a reasonable basis. Nor was there any incentive for the men to try to build up an " industrial character." Apart from the fact that foremen taking on workers at a particular stand might get to recognise the " regulars " and give them a preference, the steady worker was more or less on a par with the shiftless man trying to get an odd day's work to keep going.

In some ports experiments were tried of classifying the workers so as to establish a nucleus of men who, though not guaranteed a definite amount of work, would be taken on first and would, therefore, have fairly regular employment as long as there was work to be done. None of these experiments was successful. The success or failure of such a scheme turns on the size of the register of the preference class in relation to the average amount of work available on the one hand, and, on the other, on the ability to merge the separate pools of labour at each employer's stand into one pool for the port as a whole. In this way, a scarcity of labour in one part of the port might be made up by a surplus elsewhere instead of adding to the names on the register. But there was always endless controversy about the organisation. Workers were anxious to keep down the size of the register, and employers were equally anxious to add to it, and it soon became evident that numbers could not be reduced to a reasonable total without some financial inducement. Nor, similarly, could workers be persuaded to move freely about the port unless their pay, in some way, depended upon their doing so.

The war created the opportunity and provided the spur to further action. It was essential that labour should be used most economically and the idleness of men hanging about whilst they waited to be called on could not be tolerated while other industries were desperately in need of workers. The anxiety of port employers to have a reliable supply of workers and the power of the Minister of Labour to control the movements of everybody enabled the difficulties that had been thought insuperable, before the war, to be speedily overcome and schemes were instituted and operated with such success that they became the basis of the post-war reorganisation of dock labour which, it was hoped, would abolish casual labour for ever.

(*To be continued*)

Lapping Oils.—We are informed by Engis, Ltd., 25, Victoria Street, London, S.W.1, that it has introduced a new lapping oil for diamond impregnated wheels, laps, &c., which is designed to prevent glazing and loading and at the same time impart an improved tool finish to the workpiece besides lengthening the life of the wheel. " Hypol," as the oil is known, is applied by means of a small hand spray to the revolving wheel and this has the effect of forcing the oil into the wheel. Foreign substances are thereby ejected and at the same time the oil lubricates the wheel, keeping it clean and sharp. The makers say that the oil can be suitably used on grinding operations on carbide tools, wire and tube drawing dies, bushes, guides, boring-bar diamond wheels, &c., and similar types of grinding wheels.

Atomic Energy in 1952

THE chief event in 1952 was the carrying out of the first, and highly successful, test of the British atomic bomb; it took place in October in the neighbourhood of the Monte Bello Islands with the fullest co-operation of the Australian Government. The results of the trial were made public—though in token form only—at the end of the month by the Prime Minister in a statement to the House of Commons. Some photographs are reproduced in Plate I facing page 12.

A less important, though much fuller, release of information during the year was the publication of a report on certain of the chief aspects of recent work at the Government Atomic Energy Research Establishment at Harwell under its Director, Sir John Cockcroft, F.R.S.

On the other side of the Atlantic, the U.S.A. Government continued its lavish provision of energy and dollars, chiefly through the medium of its Atomic Energy Commission, whose eleventh and twelfth semi-annual reports were issued during the year. These showed a very striking degree of activity in all parts of the United States.

The Monte Bello Tests

Early in the year the important announcement had been issued from Downing Street that the Government planned to organise a test in Australian waters of a British-produced atomic weapon. The test took place on October 3rd in the neighbourhood of the Monte Bello Islands, off the West Coast of Australia, under the joint management of both Governments, and as full an account of it as security requirements permitted was given by the Prime Minister to the House of Commons a few weeks later. The Royal Navy, the Army, the Royal Australian Navy, the Royal Australian Air Force, the Australian Defence Department, and other Australian Departments, all played a part in the operations. Mr. Churchill was able to inform the House that the test had been successfully carried out and that the predictions made by Dr. William Penney, F.R.S., who had charge of the operation, were entirely borne out by what happened.

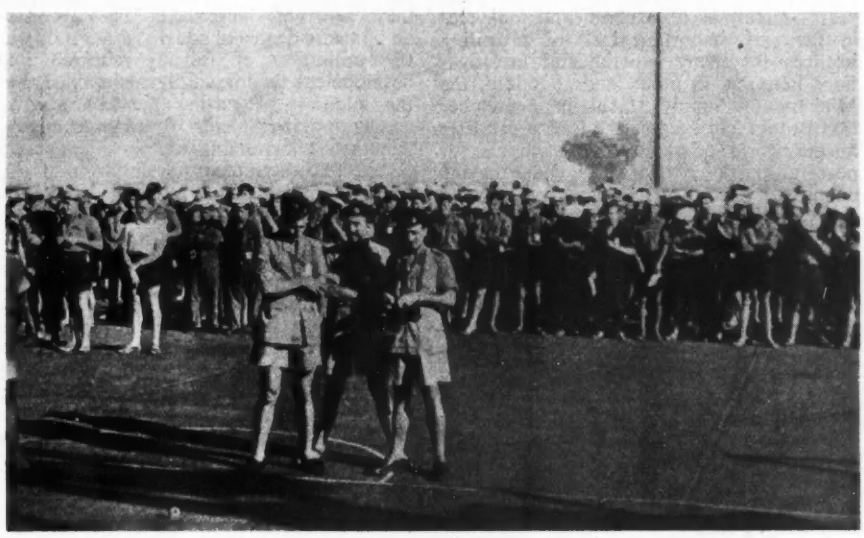
The atomic explosive was placed in the hull of an obsolete frigate (H.M.S. "Plym," of 1450 tons) anchored in the islands, and was detonated in that particular position in order to investigate what would be the underwater action of the weapon in a harbour. The little warship was seen to be entirely vaporised, except for some red-hot fragments which fell on the islands and set patches of vegetation alight. According to Mr. Churchill, the temperature when the flash burst through the hull was about a million degrees, and still higher, of course, at the detonation centre. Specimen target structures, of interest to the armed Services as well as to Civil Defence, were placed at various distances. Suitable instruments recorded blast, contamination, heat flash, gamma-ray flash, and other important factors. During the test thousands of tons of water, mud and rock from the sea bottom were cast thousands of feet into the air, and a high tidal wave caused. A further photograph on this page shows the crew of the Campania, backs turned to the glare, awaiting the order to turn about.

Vitally important as was this test, it is natural to wonder why it should not have been carried out in one of the experimental areas previously used for such purposes by the U.S. Government; but it seems that under existing American legislation (e.g. the McMahon Act of 1946) regulating the use made of information concerning atomic weapons and fissile material, it would have proved difficult to comply with the law in the active co-operation required by both sides, in the exchange of information, and in the discussion of the results achieved. Senator McMahon himself foresaw the difficulty and understood the reasons for the British preference for an Australian site and he wished the participants every success in the venture. It is possible that in the near future the McMahon Act may be revised by Congress, for there is a growing body of opinion which holds that the present form of the Act has cut off American scientists from knowledge of what their British colleagues have been doing, and has tended to produce a situation in which British and American physicists and engineers have often been unable to interchange important information relating to their common tasks.

The Thermonuclear Reaction

As is well known, work has proceeded actively in America, (and it is possible in other countries too), with the effort to produce a thermonuclear explosive which shall make use not of atomic "fission" but atomic "fusion"—and popularly known as the "hydrogen bomb"—but any progress that may have resulted has been wrapped in the closest secrecy. A little light on the subject was, however, thrown in a statement drawn up by Senator McMahon, shortly before his death earlier in the year, and published in last August's issue of the *Chicago Bulletin of the Atomic Scientists*. That issue included an editorial opinion that the Senator, being chairman of the Joint Congressional Committee on Atomic Energy, was in a position "to know what he was speaking about," and that his reference to the hydrogen bomb as if it were an accomplished fact was probably the very first authoritative claim for the success of the project. A possible confirmation of this claim may be read into the announcement, in mid-November, by the U.S.A.E.C., that recent tests at Eniwetok Atoll in the Pacific included experiments contributing to thermonuclear weapons research, and that "the military and civilian members of the Task Force concerned accomplished a remarkable feat of precision in planning and operations."

If this is the fact and if America builds numbers of such bombs, as would seem likely, there might well result a breathing space of several years, during which it might prove possible to achieve the Senator's hoped-for agreement with the Soviet Union on a measure of general disarmament to be coupled with an allocation of the huge sums of money thus saved to finance greater general productivity in the less developed countries of the world; and so help to balance the food supply with the steadily rising population. This is certainly an ambitious project and one which can hardly be expected to reach fruition rapidly. But the enormous potential effect of the hydrogen weapon as an effective deterrent to any form of aggression by armed masses of troops, however numerous, could hardly fail to delay the coming of a "third world war." Hence the Senator was surely entitled to expect that in the meantime the world on both sides of the Iron Curtain could hardly fail to realise the advantage the less developed lands would receive from such an agreement; he added: "I would like to look forward to a meeting of the United Nations Security Council—a meeting to be attended by chiefs of state—a meeting called for the sole and single purpose of considering means of regulating all armaments and using portions of the money today poured into military budgets for bettering the lot of men."



The Crew of the "Campania" awaiting the order to Turn About

It is unfortunate that the thermonuclear reaction, however useful it may become as a deterrent weapon against aggression, seems not at all likely to be so controllable as to be a useful source of mechanical energy for civil purposes. Herein it would be at a great disadvantage compared with the uranium reaction which is readily controllable and is ready to be available for civil purposes immediately the risk of its being diverted to other uses has been mastered—as is greatly to be hoped it soon will be.

Harwell

Although, since its creation in 1946, the British Atomic Energy Research Establishment has had certain of its activities made public, it was not until June last that a

comprehensive official account of its work was included in official papers released by H.M.S.O. It is made clear in its preface that not all items of the research programme can be described, and that in some instances there had to be a somewhat arbitrary selection. Much had been released previously in some measure and is only included to make the story complete or to show the relation of certain work to the programme as a whole.

According to a statement lately made by Sir John Cockcroft about 40 per cent of Harwell's work is devoted to problems of production establishments and about 60 per cent to civil application of atomic energy. One-third of the effort is, in the main, research and two-thirds development.

"Gleep," the first reactor to be built at Harwell, was begun in 1946 and completed in the following year, since when it has been running for most of the time at twenty-four hours a day. Its power was limited to 100kW and its design made so simple that it could be quickly made available for experimental work, especially in the testing of the quality of materials proposed to be used in reactor construction. Later on the larger reactor, "Bepo," of 6000kW, was constructed, and this came into use in 1948. Although "Bepo" is sixty times the power of "Gleep," it is not much larger, since the power is governed less by dimensions than by the limit of the safe temperature at which the reactor may be operated, and, therefore, by the rate at which the heat generated can be removed. "Bepo" has been running at high power for over three years—mainly as an experimental tool, and in the very important task of providing isotopes for many experimental investigations here and in other lands. Indeed, the Ministry of Supply stated in September that Britain had become the largest exporter in the world of radioactive materials for peaceful purposes, Harwell's share having comprised over 3000 consignments sent to thirty-seven different countries within the twelve months ended in June.

Another important aspect of the Harwell work is the mineral dressing laboratory in the Chemical Engineering Division. Hitherto the world has drawn chiefly on its richer deposits of uranium but, as the demand increases, much lower-grade deposits have to be worked, and unless this can be done reasonably economically the application of atomic energy to civil power production may fail to prove a really economic proposition. Similar work, as it happens, is being undertaken at the University of Nevada, at the instance of the U.S. Government.

Harwell's original task of making a theoretical study of possible kinds of reactor having been completed, this has been succeeded by "design and feasibility" studies of the following reactors :—

(1) An enriched-uranium power unit for ship propulsion and the like.

(2) A natural uranium reactor for electric power production.

(3) A breeder reactor to economise the use of fissile material.

It is pointed out that the weight of any such units must depend largely on the mass of the necessary radiation shield, which for an output of 10,000kW may amount to some hundreds of tons.

The third of these reactors involves the co-operation of chemists and chemical engineers because of the need to separate the secondary fuel elements, plutonium and uranium 233, from the breeding materials uranium 238 and thorium. As the report states, the ideal to be aimed at would be a continuing process in which secondary fuel is extracted from breeder material more or less as it is formed ; this, it is possible, may one day be attained, but at present it is more of a chemical engineer's dream than anything else ! Its importance was stressed in a House of Lords debate last June on "Science and Industry," when Lord Cherwell emphasised the economic importance of the breeder reactor. It was possible by its use to obtain power and to breed fresh fissile material as long as there was a supply of normal thorium or uranium with which to surround the active core. He thought that by this method one might be able to use the whole of the uranium, or at least a very large proportion of it—perhaps 60 per cent or so. It may well prove to be a long-term investigation, and to require in the end considerable capital investment. But Lord Cherwell was sure that it would be worth attempting, and that the prospect of success was considerable, perhaps within a few years.

During November an important conference was held at Harwell to enable representatives of Canada and the U.K. to discuss the subject of their technical policies, including the nature of their immediate and long-term objectives in relation to the industrial application of atomic energy, the economics of nuclear power production, and the preparation of special materials necessary to these programmes. The conclusions reached have not so far been published.

The U.S. Atomic Energy Commission

During the year the U.S. Atomic Energy Commission presented to Congress its eleventh and twelfth bi-annual reports, and they were duly published. They recorded an immense degree of activity ; not only was the utilisation of existing research and development facilities fully maintained, but the addition of further facilities was so accelerated that almost 3 per cent of the American construction labour force is estimated to be devoted to work on atomic energy developments of one sort or another. Moreover, further expansion has since been approved, which should eventually add plant valued at 3500 million dollars to the atomic energy equipment of the U.S.A. As is inevitable in the world as it is to-day, the greater part of this immense effort is devoted to military requirements. This fact is the more understandable since recent work has shown the possibility of the tactical use in warfare of atomic weapons. Indeed, one of the latest Press reports suggests that atomic bombs weighing no more than 2000 lb apiece, and capable of being carried on modern fighter aircraft are now feasible ; if this is confirmed the greater will be the power to repel any aggressive action by masses of invading troops, however large.

Early in 1952 there was completed at the National Reactor Testing Station in Idaho a large reactor especially designed for the testing of materials for use in reactors of new design. Another plant lately set to work at the Oak Ridge Laboratory has been given the task of improving the efficiency of radiation shields—a very important requirement. The use of such screens to protect those who work near nuclear reactors is a common precaution, but in the case of mobile installations their use adds greatly to the total load to be carried. It would make a great difference if some lighter substance were discovered which would be equally effective, especially in the extreme case of the application of atomic power to aircraft. This lends a certain interest to an unconfirmed Press rumour, repeated in other countries, that there had been lately discovered in the U.K. a "new alloy" suitable for use as an effective shield for aircraft use. But, according to *The British Atomic Scientists News* (September last), the Ministry of Supply reports that it knows of no published information in support of this statement.

Considerable progress is reported in the American efforts to build atomic powered submarines—and preliminary design work is also proceeding in the drive towards aircraft propulsion by nuclear power. As regards the former it has been known that the U.S. Government has been working for some four years on the production of atomic engines suitable for submarine propulsion and during the year 1952 President Truman announced that the project was nearing completion ; although it had been at one time expected that the work might take as much as ten years. Our own Ministry of Supply is understood to have initiated, some two years ago, design studies bearing on submarine propulsion by atomic power, and, as might be expected, the Admiralty has also taken action. It is also interesting to learn that there is a considerable endeavour being made by several groups of American business firms to enter the "reactor business," or at least to explore its possibilities.

International Nuclear Research

At a meeting in Copenhagen in June a scheme was discussed for the building of a nuclear research station for the joint use of Belgium, Denmark, France, Germany, Italy, Holland, Sweden, Norway, Yugoslavia and Switzerland. The research work proposed to be undertaken, making use of a site near Geneva and costing some 25 million dollars, would aim not at a military or a civil target, but have as its objective an extension of the basic knowledge of nuclear processes ; with the intention that the results achieved should be freely published for the information of the entire scientific world.

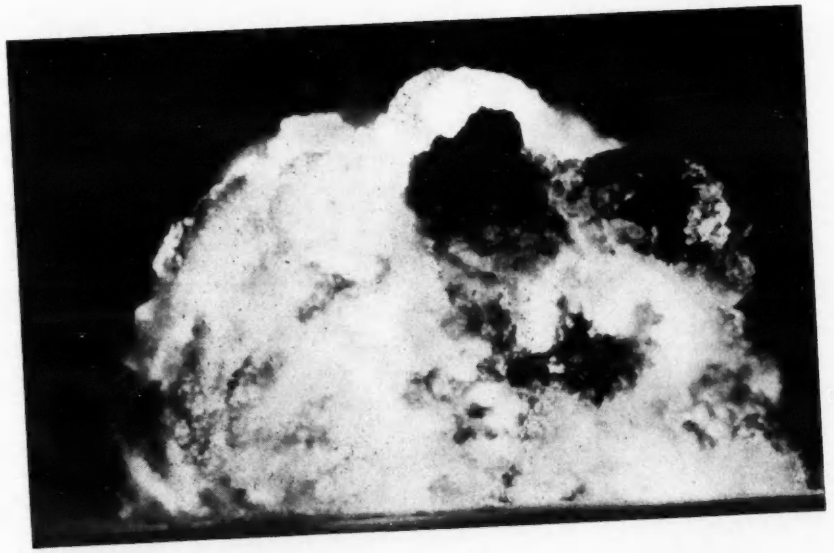
Important pioneer work is also in hand at the U.S.A.E.C. laboratories having the object of discovering the nature of the unknown forces which bind together the neutrons and protons in all atomic nuclei. This, if it succeeds, may indicate means for producing an enhanced release of the energy stored in the atom.

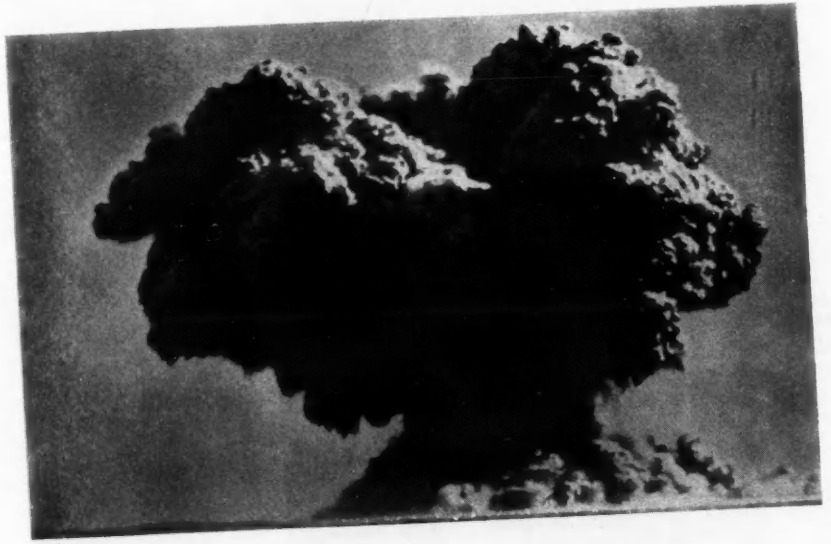
On the whole it may certainly be claimed that the most important news of the year is the highly successful performance of our home-produced atomic weapon. It is especially important to engineers since, quite apart from its use in the prevention of military aggression against this country, it indicates that a new national source of fissile material may become available for useful civil energy production in the coming years.

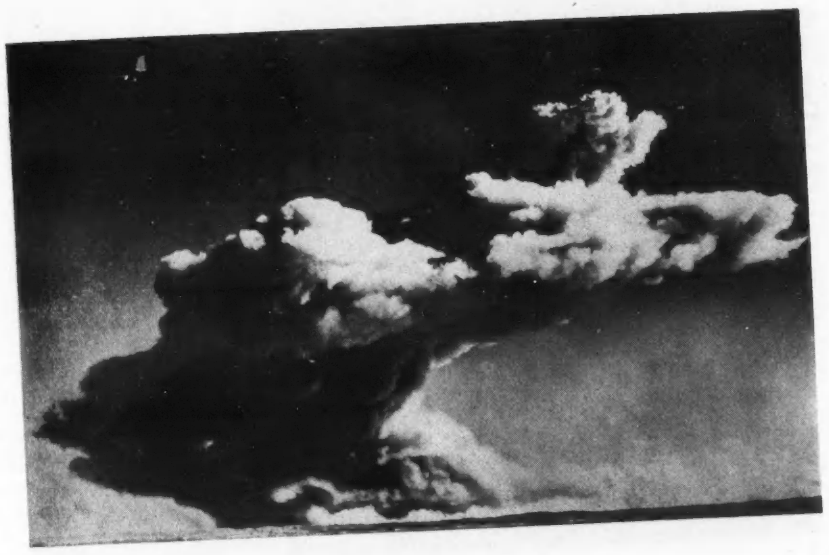
The marked success of the Monte Bello test emphasises the growing importance of the question whether the present almost complete nationalisation of the U.K. atomic energy endeavour can conceivably promote progress as fully as would the encouragement of British industry to take as full a share in the enterprise as is now common in the U.S. Surely our authorities could learn a lesson from recent home-experience by realising the immense advances made through "private endeavour" in the sister field of aeronautical engineering.

Fifty-Cycles-per-Second Electrification—Lancaster, Morecambe and Heysham Line.—In our issue of December 12th (page 801) we published a short announcement on the Lancaster-Morecambe and Heysham Electrification, based on a statement from the London Midland Region of the Railway Executive. Additional information from the same source enables us to state that the English Electric Company, Ltd., has provided the electrical equipment on the three trains involved in this experimental electrification, and the British Insulated Callender's Cables group of companies has supplied the overhead equipment.

THE MONTE BELLO ATOMIC EXPLOSION, 1952

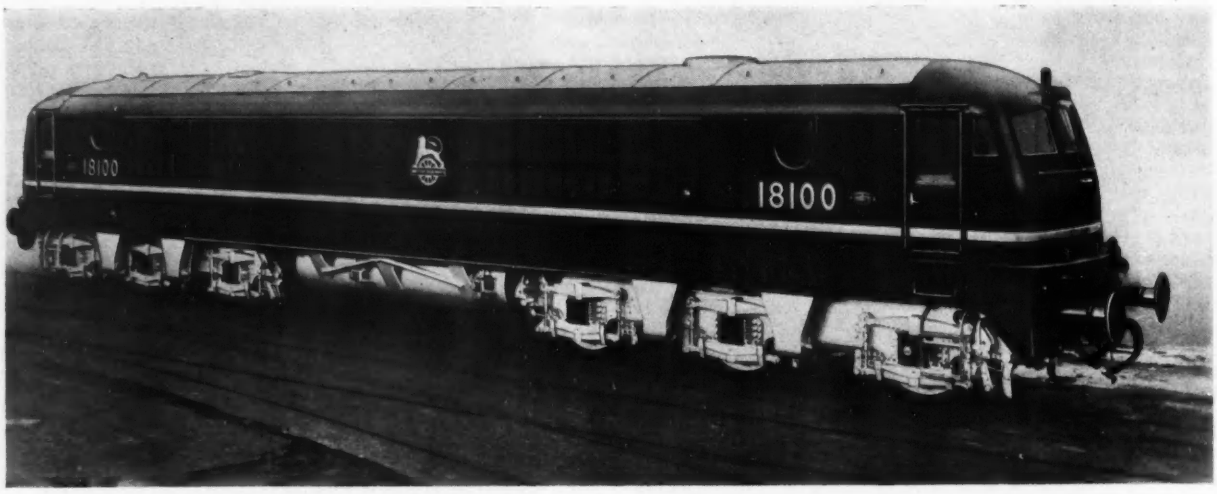




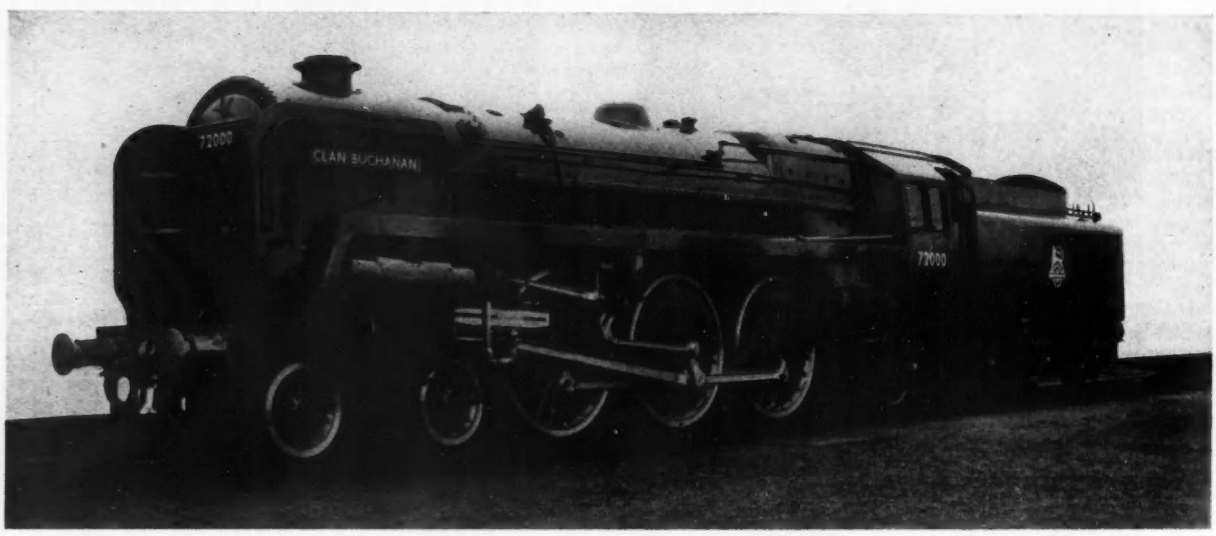


Successive Stages in the Development of the Explosion

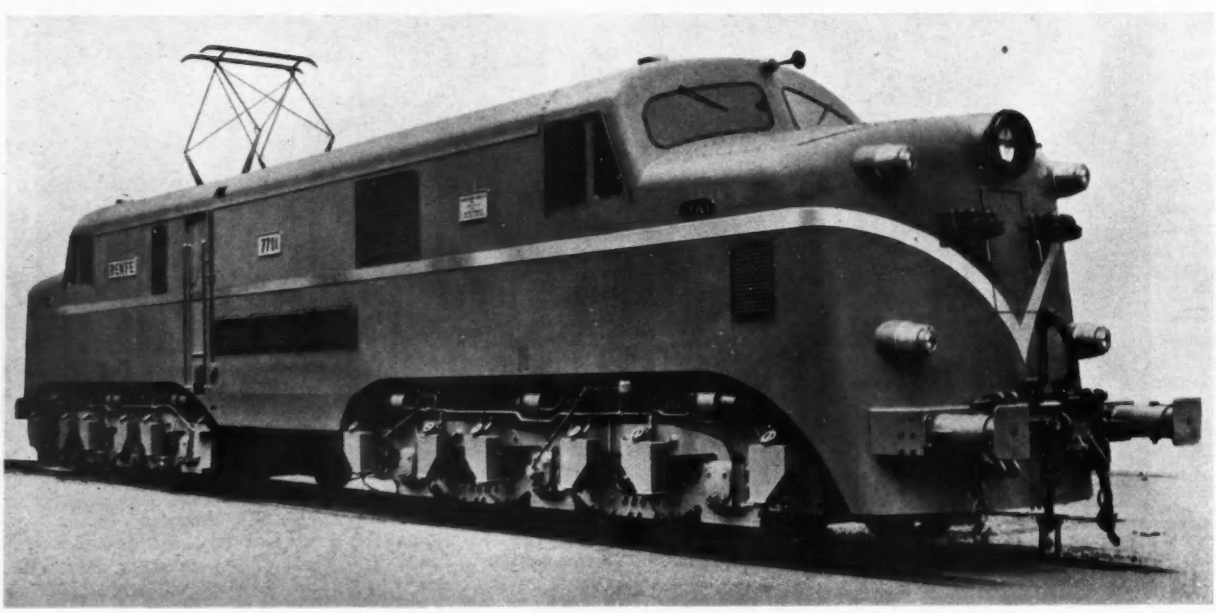
LOCOMOTIVES OF 1952



3000 H.P. Gas Turbine Locomotive for British Railways

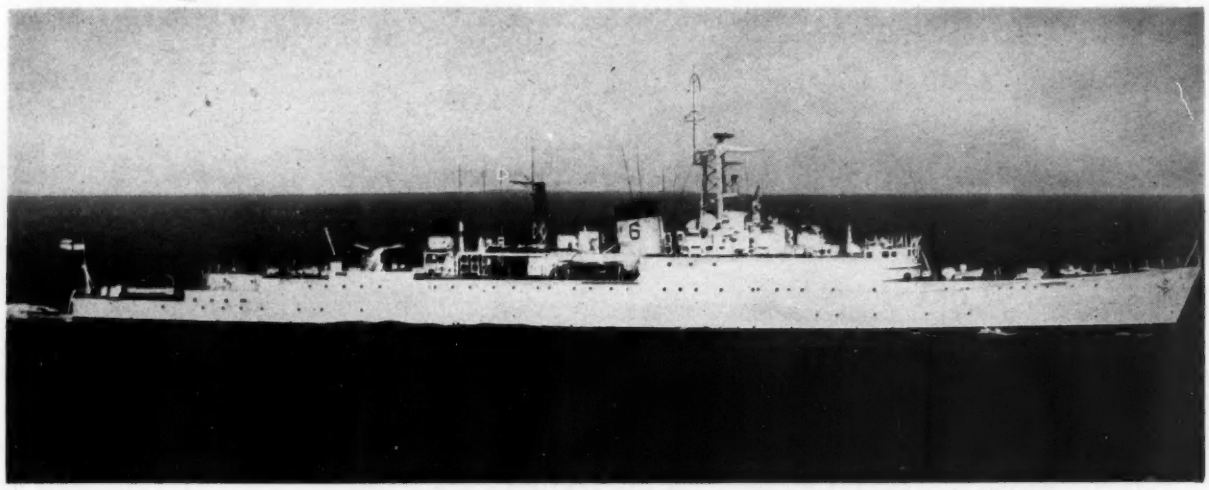


4-6-2 Standard Class "6" Locomotive for British Railways

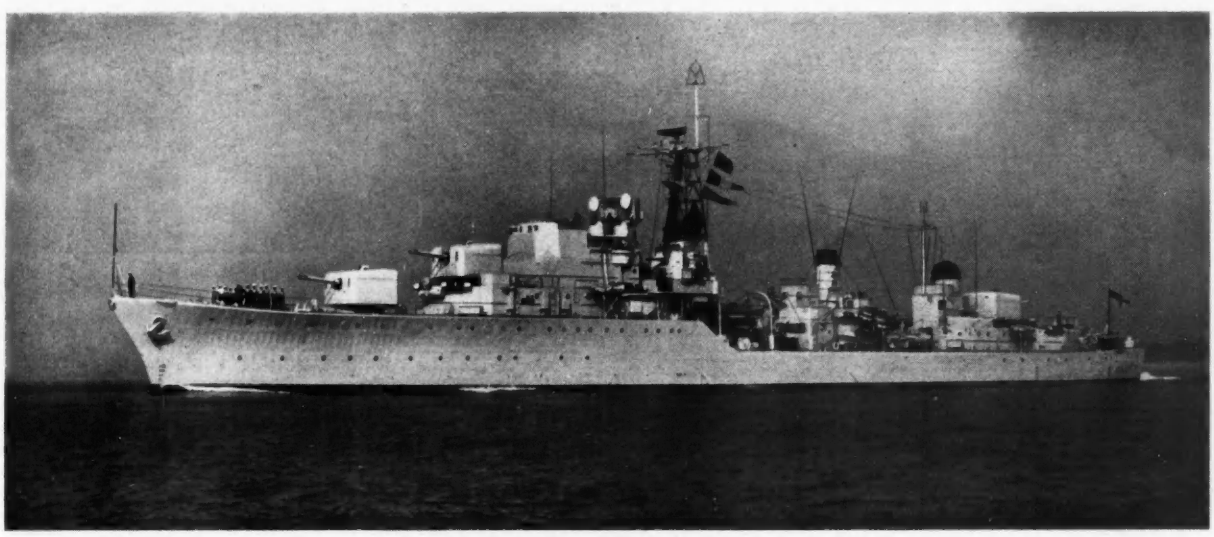


3600 H.P., 3000V D.C. Locomotive for Spanish National Railways

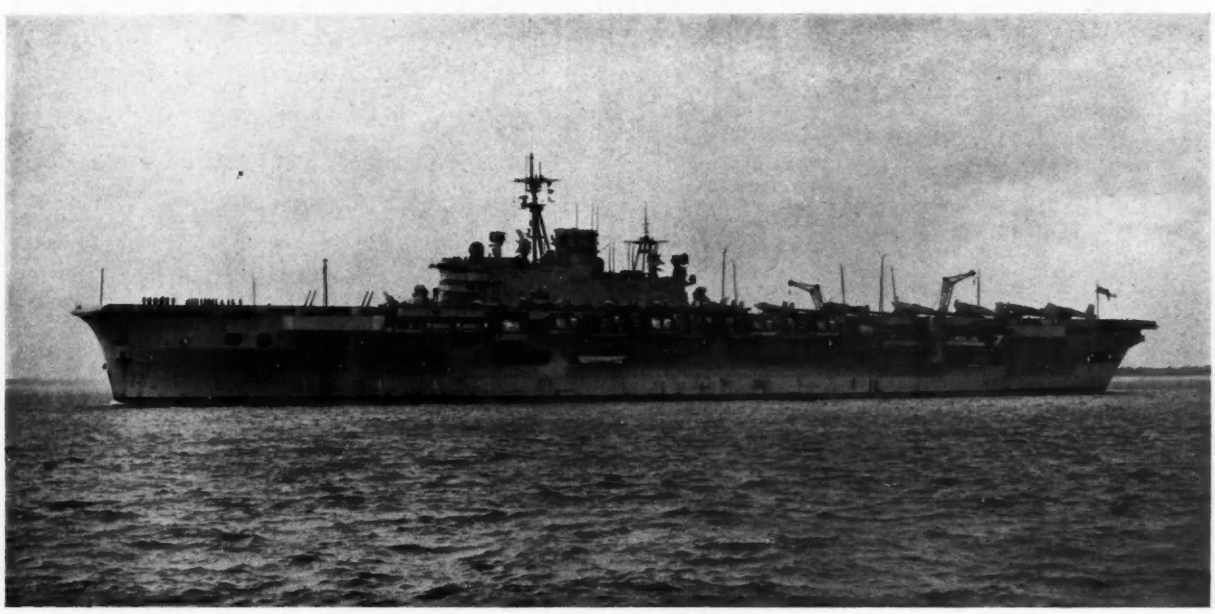
BRITISH WARSHIPS OF 1952



H.M. Frigate "Venus"

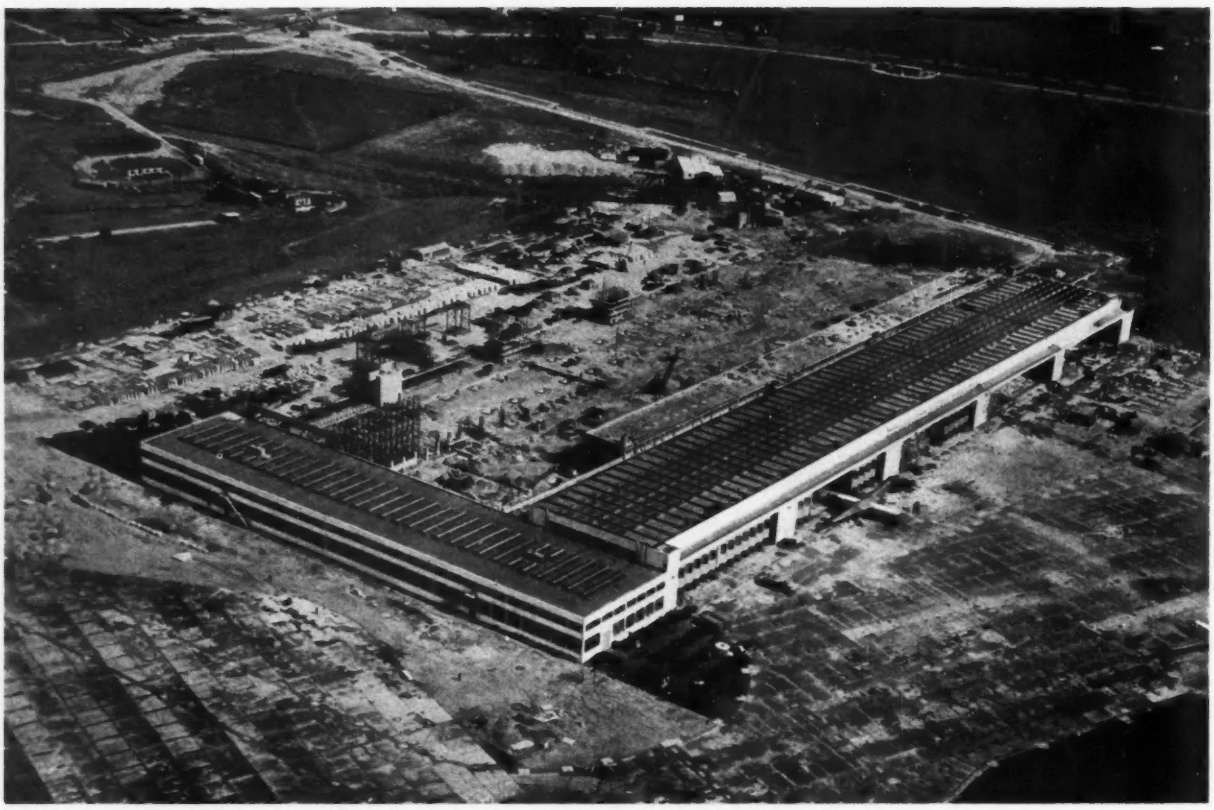


H.M. Destroyer "Diamond"

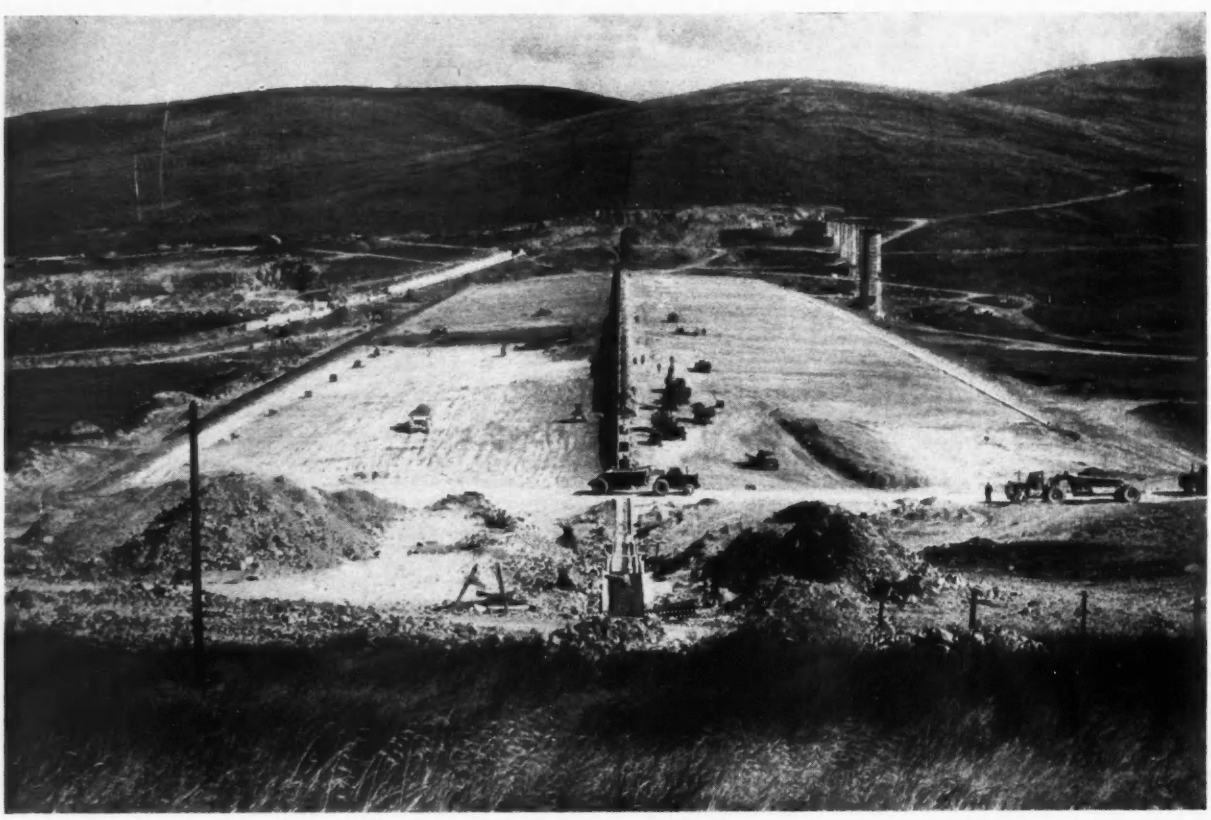


H.M. Aircraft Carrier "Eagle"

CIVIL ENGINEERING IN 1952



B.E.A. Hangars at London Airport



Construction of the Daer Dam

Civil Engineering in 1952

No. I

"THE general conditions under which the science of civil engineering is carried out have few parallels with any other calling. The civil engineer must go to where his problem lies; he must start from nothing and he must take his material and the medium in which he works exactly as Nature has laid it down in all her innumerable varieties and incalculable moods. So the civil engineer's work in the field must, by its very nature, be primitive, and from its vast size be the concern of a number of men. His machines must go to the work, and not the materials to his machines; they, of necessity, are generally powerful, brutish and primitive." It is our intention to review in the columns below some of the problems which, in their innumerable varieties and under such conditions as are outlined in this quotation from the 1952 James Forrest Lecture,* confronted the civil engineer in 1952, and to give some examples of various schemes which were under construction during that year. The general pattern of the year's work followed along the same lines of partially restricted activity that have been characteristic of the past few years and the remarks made in our review at this time last year about the paucity of capital available for civil engineering development in this country were still generally valid. Thus the balance between activity in the various branches of the civil engineering remained much the same as in the last few years.

Three major civil engineering schemes which have been under construction for a number of years—the Claerwen dam, the Maple Lodge sewage disposal works, and the Affric hydro-electric scheme—were completed and officially inaugurated during the course of the year. Another event of some importance was the fourth congress of the International Association of Bridge and Structural Engineering, which was held in Cambridge and London last August and September. All of these events were referred to in THE ENGINEER during the course of the year, so that in the columns below reference will be made principally to other topics, representative of the civil engineering industries' activities during 1952.

First we refer to Plate 4 opposite, where the lower illustration shows the progress of the construction of the Daer earth-fill dam. This dam is under construction for the Daer Water Board, and the reservoir which it will form will supply the County Council of Lanarkshire, the Airdrie, Coatbridge and District Water Board, the Town Council of Motherwell and Wishaw, and Hamilton Town Council, all of these bodies being represented on the Board. The Daer is one of the head waters of the Clyde and rises near the southern border of Lanarkshire, the site of the dam being in that county. The completed structure will be 135ft high and half-a-mile in length; the gathering grounds consist of 11,500 acres of typical Scottish moorland.

Last year was the fourth in which work continued on the construction of this impounding dam. Some 1,400,000 cubic yards of consolidated embankment were in place by the end of the year, bringing the height of the dam up to a level of 1060ft O.D., the top water level of the reservoir being 1122ft O.D. The ancillary works for the valve tower, access bridge, stone toes and discharge channel were all in an advanced stage of completion. The work is being carried out by direct administration.

Considerable progress was also made during the year with the constructional work for the filtered water reservoir and other parts of the treatment works. These works when completed will be capable of treating 25 m.g.d., which is the estimated quantity which the Board will be able to obtain for supply purposes from this scheme. Three contracts were let for the laying of about 56 miles of pipe-line from the headworks to the terminal reservoirs. The pipes are of steel, internally lined and externally sheathed with bitumen and varying in outside diameter from 45in down to 21½in. Reinforced concrete piles were being driven for the foundations of the mass concrete abutments and central pier of a double-span steel girder bridge to carry the pipe-line across the River Clyde.

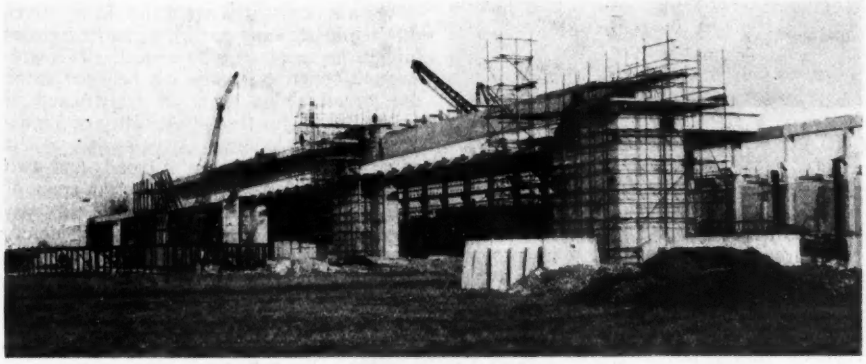
The illustration of Daer dam in Plate 4 shows the progress of the works towards the end of the year. The articulated concrete core wall is in the centre and, on the right, in the middle distance, the partly built valve tower and the piers for its approach bridge may be seen. The spillway channel may also be seen under construction on the left of the illustration and the Daer water may be perceived, both in the middle distance. The consulting engineers for the complete Daer scheme are Messrs. Binnie, Deacon and Gourley.

LONDON AIRPORT

The upper illustration, on Plate 4, shows the prestressed concrete hangars which were under construction during the year for British European Airways at London Airport. A considerable volume of work was in progress at the airport during the year and this set of hangars constitutes one of the major items. The design of the hangars has aroused much interest and they were the subject of papers presented to both the Institution of Civil Engineers and the Institution of Structural Engineers. The contract was awarded as the result of a competition organised by the Ministry of Civil Aviation, with tenders based either on steel, reinforced concrete or prestressed concrete. The winning design combined reinforced concrete and both precast and *in situ* prestressed concrete, with small quantities of aluminium and steel. In the complete structure there will be two sets of five hangars, each forming one continuous building with a clear interior space of 900ft by 110ft by 43ft in height; the two sets are joined together by a workshop block; Plate 4 shows the progress last June, when the first of the sets of hangars and the workshop block were virtually complete, with construction in its early stages on the second set.

The group of ten hangars and workshops

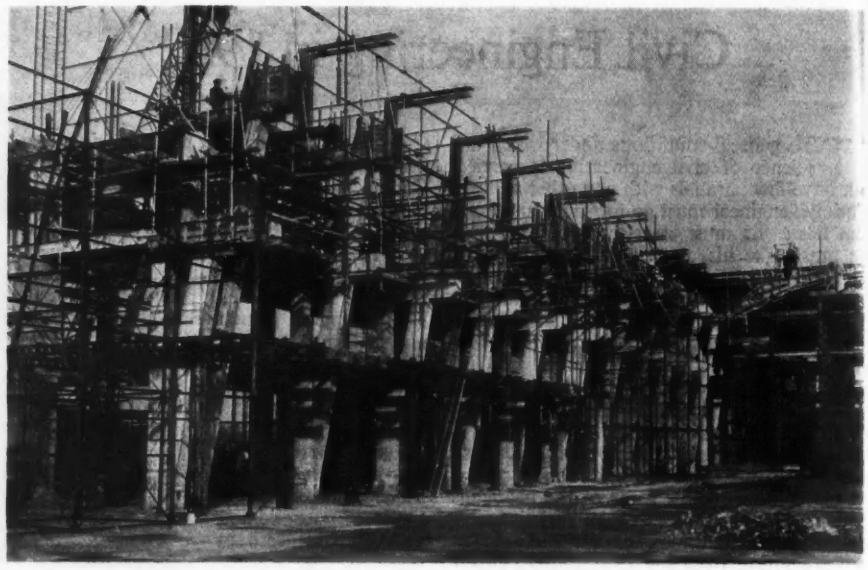
Construction of Access Tunnel to Terminal Area at London Airport



Prestressed Concrete Hangars Under Construction at London Airport

* "The Progress of the Science of Soil Mechanics in the Past Decade," by H. J. B. Harding, *Journal I.C.E.*, Nov., 1952.

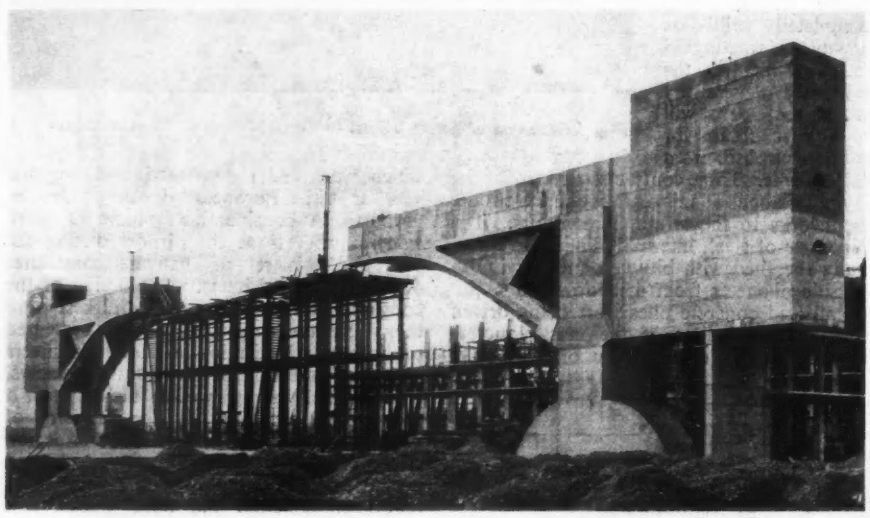
is thought to be one of the largest prestressed concrete buildings yet erected. Structurally, the hangars each comprise a hollow rectangular primary beam 14ft deep and 5ft 3in wide, spanning 150ft and carried on hollow box-section reinforced concrete pylons. The primary beam was cast *in situ* and post-tensioned, with precast stiffening diaphragms placed at 15ft intervals, which served to position the cables and to carry the crane-rail brackets and the canopy cantilevers, as well as the direct loads from the secondary beams. The webs of the primary beams were 4in wide and the top and bottom concrete depths were, respectively, 8in and 5½in ; the prestressing cables were embedded in the concrete. The secondary beams were cast in short lengths, then assembled, tensioned and erected. They were "T"-beams spaced 15ft apart and spanning 110ft, being 3ft wide across the flange and 6ft in depth. Light precast, prestressed purlins and aluminium decking completed the roof. The accompanying illustration shows the construction of the pylons and the primary beams well advanced, and one of the secondary beams is shown in position on the right-hand side of the illustration.†



Column and Roof Structure of Hangar of B.O.A.C. Maintenance Base

The general layout of the hangars was arranged to give the maximum efficiency in the maintenance of B.E.A.'s aircraft, economical maintenance being a crucial matter in the successful operation of an air-line, so that the various mechanical and electrical engineering services provided accounted for more than half of the cost of the work. The B.E.A.'s consulting engineers for the hangars are Messrs. Scott and Wilson and the main contractors are Holland and Hannen and Cubitts, Ltd., which firm carried out the structural design in collaboration with the Concrete Development Company, Ltd., and the Prestressed Concrete Company, Ltd., Mr. A. E. Beer being retained by the contractors as consulting engineer.

Work was also in progress during the year on the access tunnel under No. 1 runway, from the Bath Road to the new main south terminal disembarkation area, traffic being diverted to No. 5 runway. As may be seen from the accompanying illustration, which shows the progress in April, 1952, cut-and-cover methods were employed. The tunnel is about 2000ft long and 80ft wide and is of reinforced concrete ; it has two 23ft wide carriageways for the main traffic and two suspended cycle tracks, with the road surface some 30ft below ground level and 10ft of cover over the roof. A total of some 600,000 cubic yards of excavation was involved in the work. The travelling wall shutters may be noted in the illustration, as may the two 7-ton derricks with their 2 cubic yard concrete skips. Of the total length of 2040ft, the base slabs and walls are shown constructed to a distance of 1750ft, and the roof slab to 1350ft. The No. 1 runway crosses the tunnel where the small huts may be seen to the right of the illustration. Back filling and compacting plant may also be seen in operation on the line of the runway, with the north track behind being reinstated. The tunnel was substantially completed by the end of the year, being built for the Ministry of Civil Aviation under the direction of the Air Ministry works directorate with Taylor Woodrow Construction, Ltd., as the main contractors.



Construction of Hangar Portal of B.O.A.C. Maintenance Base

A large contract was also in progress during the year, though in its early stages, for the construction of terminal buildings and central heating stations at the airport. Yet another contract of more than usual interest concerned a central maintenance base for British Overseas Airways Corporation. This structure is of reinforced concrete, measuring 840ft long and 430ft wide, with an overall height of 100ft. The illustrations reproduced here (also taken last April) show first the counterbalanced cantilever construction of the entrance of the eastern hangar, with the staging for the portal girder in position, and, second, the construction of the columns and roof structure in progress. The span of the portal structure in the illustration on this page is about 150ft, the central girder being 18ft deep and the total dead load about 1000 tons. The consulting engineers for the B.O.A.C. maintenance base are Sir Owen Williams and Partners and the main civil engineering contractors W. and C. French, Ltd.

A Prestressed Concrete Road Bridge

Our annual review of civil engineering works published in January, 1950, noted that during 1949 a very great interest had been shown in prestressed concrete construction, but that examples of prestressed concrete structures in this country were then comparatively rare. Interest in this constructional medium has been very great since that time, but the development of the subject has now reached a more mature stage, where a number of impressive structures have been erected, and 1952 saw substantial progress in this respect. The B.E.A. hangars described above are a case in point and yet another example is given by a highway bridge recently completed in Abercave, near Swansea—the New Castle bridge.

The bridge provides a crossing over the River Tawe to a road diversion, eliminating a dangerous crossing over the same river through an existing narrow bowstring girder bridge, made of structural steel. This prestressed concrete structure is believed to be the largest single span yet constructed in Great Britain for the full Ministry of Transport standard loading. It comprises a 22ft carriageway for a Class A road, and two footpaths, 10ft wide, over a clear span of 80ft.

An arched rib design was first considered, especially on account of the nature of the ground, which was reputed to be rock. On second consideration, however, and in view of the pronounced skew of the bridge, a simple girder design was found to be more suitable. No restrictions were given as to structural depth and the structure took the

† A fuller description was given in The Engineer, Oct. 31, 1952.

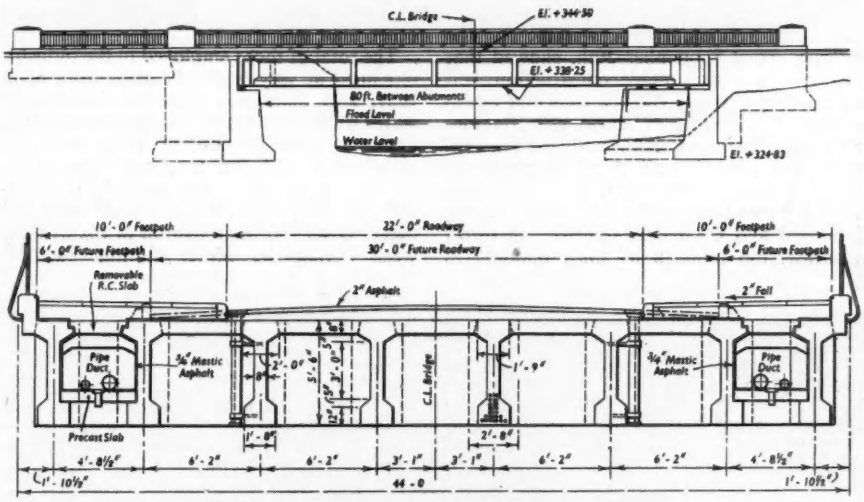
shape of eight precast, prestressed deep girders, carrying a reinforced concrete decking cast *in situ*, and containing a number of post-tensioned parabolic cables. The use of deep girders was possible here and was found to be economical, thus giving an interesting contrast with some of the very slender bridges associated with prestressed concrete construction. The girders, being simply supported, required a far smaller amount of foundation work than would have been necessitated by an arched structure.

The large saving in foundation work became fully apparent when the excavation revealed that a thrust-bearing stratum was not available at normal depths, and that an arch would have required either raking piles or massive footings sufficiently heavy to provide resistance to thrust through frictional forces. As things stood, the simply supported girders required only the more normal mass concrete retaining wall, with wing walls.

The eight precast girders are of an "I" section, 85ft long and 5ft 6in deep and of a unit weight of 38½ tons. The top and bottom flanges are 24in wide and 20in wide respectively, and the web is 8in thick, as shown in the illustration below. There are twenty Freyssinet cables in each of the intermediate beams and fourteen cables in the edge beams. The cables are placed close together in the bottom flange at midspan and rise on a curve towards both supports, thereby providing resistance to shear forces. A 4in web would have been sufficient to resist the shear stresses, but it was found from previous experience that a thickness of 8in would be required to facilitate the placing of the cables and reduce frictional losses to acceptable values. The 0·2in diameter steel prestressing wires had an ultimate strength greater than 100 tons per square inch and were tensioned to 70 tons per square inch. The concrete, containing 112 lb of cement to 385 lb of sand and Pennant stone, was allowed to mature until it had reached a cube strength of 6000 lb per square inch. The maximum concrete compression occurred at prestressing and amounted to 2200 lb per square inch after relaxation in the steel.

Completed Road Bridge Over the River Tawe

Consideration was first given to the possibility of casting the beams on the bank and launching them across the river by means of masts. On second thoughts it was found more expedient to erect a temporary steel bridge crossing the river between abutments, placed on the central line of the new work, and made wide enough to cast one pair of beams. Only one set of beam shuttering was used for the job. The beams were cast, left to mature and prestressed on this temporary support. After prestressing, each beam was lifted from its soffit by two 25-ton jacks and lowered at each end onto a two-wheeled bogie carried by a rail running along and on top of each abutment. Two 5-ton horizontal jacks, leaning against a stop fixed to the rail, were used to move the beam along the abutment to its final position, where it was jacked down onto its roller and rocker bearings. The beams were cast at the rate of one pair every five weeks, and with the four pairs in their final positions, the construction of the deck slab, services ducts, footpath and roadway, proceeded in the usual way. The completed bridge is shown in the illustration above. The bridge was built under the authority of Mr. J. M. Richards, M.I.Mun.E., County Surveyor of Brecon; R. M. Douglas (Contractors), Ltd., were the contractors, and L. G. Mouchel and Partners, Ltd., the consulting engineers.



Prestressed Concrete Road Bridge Over the River Tawe

Another prestressed concrete bridge erected during the year was the 160ft span single-track railway bridge built across the River Don at Rotherham. This bridge employs the Lee-McCall system of prestressed concrete, a British system which has made great strides since its inception two and half years ago; the system was adopted during the year for the construction of 17,500ft of bridge trestling in the United States, forming part of a toll bridge 15 miles in length, crossing the Lower Tampa Bay in Florida. The Don railway bridge was described in THE ENGINEER of December 12, 1952.

One more event in the prestressed concrete world must be noted. Early in the year the prestressed concrete footbridge, built for the Festival of Britain at the South Bank site, was tested to destruction. Some instructive lessons were learnt from this test, the results of which were not entirely free from controversy. The testing was described and commented upon in THE ENGINEER of May 23 and May 30, 1952.

(To be continued)

Export of Electrical Equipment to Canada

A BOOKLET entitled "The Canadian Standards Association Approvals System" has just been published by the British Standards Institution to assist manufacturers interested in exporting electrically operated equipment to Canada. Difficulties were experienced by firms owing to the necessity for all electrical equipment destined for use in Canada to comply with the regulations laid down by each Province. These regulations not only differed widely from British practice, but they also varied from Province to Province, so that a piece of equipment accepted for use in one Province might still be rejected by the electrical inspectorate of another Province.

Eventually all these requirements were embodied in the Canadian Electrical Code; the Canadian Standards Association undertook to examine and test equipment for compliance with the Code, and all inspection authorities throughout Canada agreed to accept C.S.A. approved equipment. Most of the Provinces have gone a stage further by enacting legislation which makes it an offence to offer for sale or to install any equipment not approved by the C.S.A.

Even this procedure commonly involved British manufacturers in lengthy negotiations with the C.S.A. Approvals Laboratories and in considerable cost, for, although Canadian buyers were ready to place orders, some British firms found it impossible to transact the business on a satisfactory and economic basis.

Following the visit of a mission to Canada, the British Standards Institution agreed to function as the agent of the Approvals Laboratories Division of the Canadian Standards Association, and to set up an organisation through which British manufacturers could obtain C.S.A. approval in this country.

The new booklet gives exporters full details of the working of the C.S.A. approvals system and the operation of the agency in London.

Shipbuilding and Marine Engineering in 1952

No. I

THE total volume of shipping on the order books of the British Shipbuilding companies continued at a high level, so that, broadly speaking, the industry faced the new year with berths full and ships to lay down. If the order book were the only criterion for measuring the economic position, then those in the industry could feel fully assured of the future and that full employment would be maintained. There was, however, another important factor which had a considerable bearing upon the general position and its effect became more apparent by the third quarter of the year. This was the continued shortage of steel, and it had the effect of reducing the tonnage under construction so that the production rate of the industry was geared down to the rate of steel supply. Thus the anomalous position arose of possible unemployment with contracts in hand.

There was some improvement in the level of employment in the ship repairing industry compared with 1951. It cannot be said that all establishments were fully employed during the year since there were some lean periods. However, taking the large view, the volume of work involved in surveys, conversions and voyage repairs, plus the work on vessels of the Reserve Fleet, was sufficient to keep the ship repairers fairly busy.

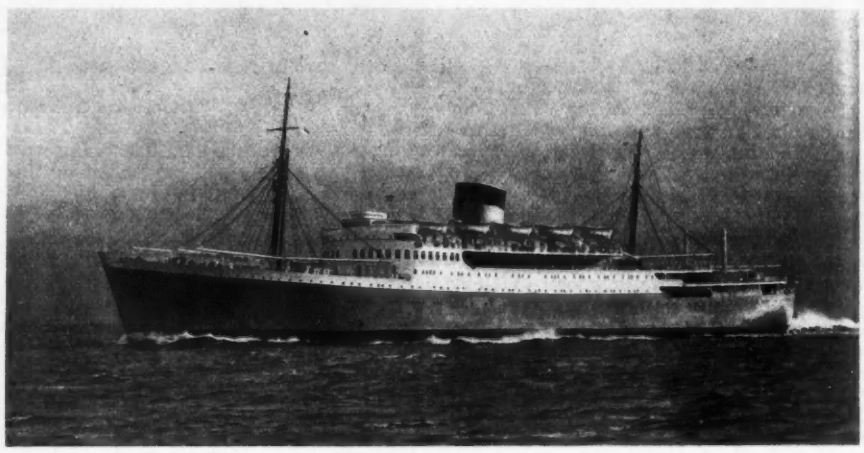
Ships contracted for by British shipping companies numbered more than 800 of about 4,500,000 gross tons, while foreign owners had placed orders for approximately 250 ships, representing 2,300,000 gross tons, making a grand total of over 1000 ships of about 6,800,000 gross tons on the order books. The value of these contracts approached £670 million, of which approximately one-third was to foreign account. Such a large volume of tonnage represents approximately five years' work at the average annual rate of production of 1,350,000 gross tons, which has obtained in recent years, so that without any additional contracts the berths will remain full until the end of 1957. Naturally this period is contingent upon the supply position of many items, mainly steel, so that unless an improvement is effected in the supply of this basic material this year the building period will be extended.

In 1951 the soaring freight rates occasioned by the heavy demand for cargo space, mainly due to the Korean War and to stockpiling, had the effect of expediting the placing of orders and about 4,000,000 gross tons were placed. Since then freight rates have hardened and orders for ships fell sharply, only about one-third of the previous year's total being placed, although this amount was still greatly in excess of the 1949 figure.

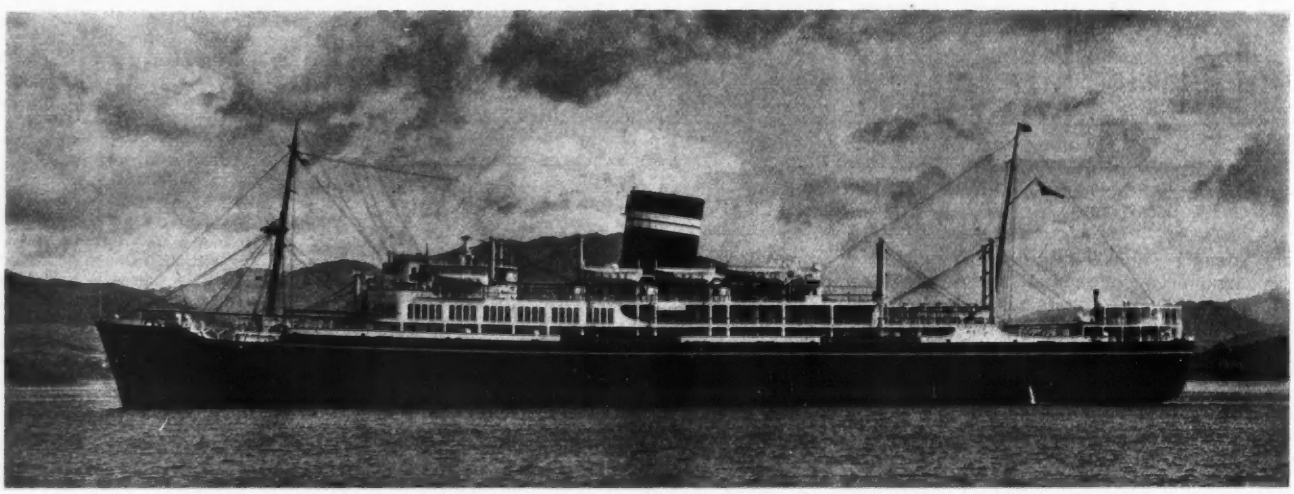
According to Lloyd's Register Shipbuilding Returns, there was a falling off in the totals from the end of the March quarter. The latest returns, those available for the quarter ended September 30th, showed that the total tonnage under construction had dropped by roughly 200,000 tons and represented 35 per cent of world construction, excluding China, Poland and Russia. In both the second and third quarters the tonnage commenced was low and this tendency was observed to be the trend of the launched and completed returns. In direct contrast, the tonnage of ships building in foreign yards continued to increase, the ships under construction reaching a new high level as did the returns for the tonnage commenced and launched.

Oil tankers continued to represent more than half, at 56 per cent, of the ships building in this country and this high percentage was maintained by the fact that 66 per cent of the tonnage for foreign account were oil tankers. An approximate division into categories of the tonnage under construction and preparing showed that the total was made up as follows: passenger and passenger-cargo liners, 6 per cent; cargo liners, 25 per cent; cargo tramps 7 per cent; oil tankers, 59 per cent; the remaining 3 per cent were colliers, coasters and others. Although there was a slight drop in tanker tonnage the order book represented an unbalanced building programme, which resulted in extended delivery dates from certain yards and early delivery dates from non-tanker building yards, which were short of orders and welcomed the signs that contracts were being placed for ships other than tankers.

The total of those employed in the industry remained at very much the same level as in 1951, and there was a further increase in wages during the year. The claim was based upon the rise in cost of living and the assumption that the additional cost could be met out of the profits made by the shipbuilders and shipowners. The effect of higher costs and the retention of the five-day week during the winter months was not



T.S.S. "Braemar Castle"



S.S. "Uganda"

immediately apparent, due to the backlog of ships to be laid down, but yards abroad attracted more orders during the year by quoting reduced prices and good delivery. As already mentioned, new orders placed with British concerns have fallen sharply, and in the ship repairing industry the increased costs and delays have caused repair work to be sent to the Continent to avoid serious loss in the ships' earnings. With Germany having nearly 500,000 tons under construction and Japan over 600,000 tons there was no room for complacency and, as stated by Sir William Wallace in his presidential address to the Institution of Engineers and Shipbuilders in Scotland, there must be a complete change of outlook and productivity must be increased by the removal of demarcation and restrictive practices.

S.S. "City of Port Elizabeth"

Throughout the year the steel supply position remained acute and the steel rationing system, although welcomed by the industry as a guarantee of fair shares, has only produced inadequate supplies which the promised increases will do very little to alleviate. Lloyd's returns of ships commenced unmistakably showed the effect of the shortage which will be only too apparent in the returns of tonnage completed or launched last year. Deliveries of steel often fell short of the allocation and out of sequence supplies caused a slowdown in construction, so that the modernised facilities in the yards were not employed economically. The industry has a capacity of 1,750,000 tons per annum, so that production running at 1,300,000 tons means higher costs. Shipbuilders stated that the yards could use 50 per cent more steel and claimed the highest priority for steel for shipbuilding, since steel built into ships earned far more foreign exchange than steel exported direct.

Costs remained high and showed no sign of falling, and prices, which reflected those in most major industries, continued to be unstable, so that fixed priced tendering was not possible. Fixed prices provide the best stimulus to efficiency, and with a severe fall in freight rates it will be necessary to attract orders by quoting keen prices, despite the fact that an attempt to do this, a few years ago, involved shipbuilders in heavy losses. In the face of growing foreign competition the upward spiral of costs is a matter of some concern, which will become of greater importance as orders are completed.

In the immediate post-war years British shipyards had a flying start over those in the occupied countries, and in 1946 commenced about 60 per cent of the world tonnage, but as the yards abroad were repaired the percentage fell to 35 in 1951 and suffered a further drop in 1952 to about 28 per cent. During the same period the industry built ships to the value of £650 million, of which £200 million represented direct export, and it carried out repair work estimated at £375 million. For the British market more than 5,500,000 tons of ships were built and a total approaching 2,500,000 tons was constructed for foreign owners, among whom Norway was our most valuable customer. Valuable orders were also received from the Argentine, France and Portugal.

Full employment in the shipbuilding industry is linked with the volume of world trade and the prosperity of the shipping companies. Shipowners sounded the alarm, on various occasions, that high costs of new tonnage, heavy taxation, unrealistic depreciation allowances, balancing charges, the new excess profits levy had reached a point where not enough money could be retained in the business to replace obsolete tonnage. Most companies succeeded in combating present difficulties because of prudent financial policies in the past, but reserves had been depleted and fleets had been barely maintained.

Since the war the country has been more than ever dependent upon the earnings of shipping, which amounted to £150 million in 1951, and were expected to surpass that total in 1952. With the size of this contribution to the balance of payments the importance of maintaining the strength of our merchant marine is self-evident, so that the decline in the percentage of world tonnage owned by Great Britain from about fifty in 1914 to just over twenty in 1952 was a measure of our weakening grasp on the trident. Concern was expressed by representatives of the industry at the decline of dry cargo tonnage, which amounted to 3,400,000 tons in 1939 and is now approximately 2,800,000 tons. Such trends are an indication of the inevitable consequences of failing to leave sufficient profit in the shipping industry with which to finance rebuilding. Another factor in the fleet replacement problem is age distribution, nearly 25 per cent of British tonnage being over twenty years old, and these old and inefficient ships must be replaced in order to maintain the quality of the shipping services. Lord Runciman, as president of the Chamber of Shipping, warned that if taxation continued to drain away the liquid resources required by British shipping to maintain the competitive efficiency of the Mercantile Marine, then our shipping would decline, with disastrous effect on the 150,000 men directly employed, and upon the welfare state.

In contrast to our decline other countries continued to build up the strength of their fleets. Many were helped by subsidies, in one form or another, such as long-term credits, taxation reliefs, including low rate of tax on money ploughed back into the industry, and direct payments.

The vital question of the turn round of ships continued to be studied and the Ports Efficiency Committee set up in March published two reports, which emphasised the need for more berthage and storage accommodation and for a larger allocation of steel to accomplish this. Apart from the rebuilding of the ports, the solution of the delays is a matter of mechanisation and organisation, and during the year the International Cargo Handling Co-ordination Association made some progress towards the solution of some of the problems. A technical conference was held in Rotterdam, at which the following papers were read :—"Open Water Loading and Discharge," "A Shipowner's Ideas About Modern Cargo Handling Methods," "Dangerous Goods," "The Human Element" "Turn Round in the Port of Rotterdam," and "Mechanical Handling —the Principal Remedy for Ship Delays."

Research and Development

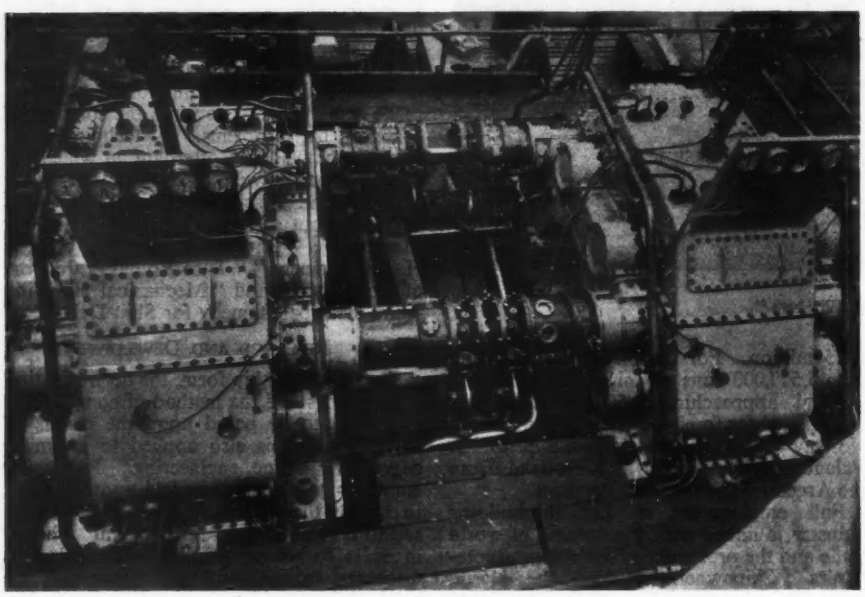
The design of ship form, the determination of scantlings and the method of construction continued to be based upon the results of research and this also applied to a similar degree in marine engineering. Politically, emphasis continued to be laid upon the need to bridge the gap between the advance in scientific knowledge and general practice in order to aid the application of scientific discovery to industrial procedure. In the shipbuilding and marine engineering industries this has been achieved by the activities and organisation of the British Shipbuilding Research Association and Pametrada. For in both organisations the research and development activities are linked with specific technical committees, which provide a common meeting ground for the scientist, the shipbuilder and the marine engineer.

Some indication of the value of the ship research which had been undertaken in this country was broadly outlined in the Thomas Lowe Gray Lecture, which was presented before the Institution of Mechanical Engineers early last year by Dr. Livingston Smith, the director of research of B.S.R.A. In this lecture, of which some abstracts appeared in the issues of THE ENGINEER dated January 25th and February 1st and 8th, 1952 Dr. Smith dealt with the more important examples of research in four main branches concerned with ship structures,

hydro-dynamics, ship performance and ship machinery. The contents of the paper were indicative of the immense volume of research upon which the Association was and is engaged. Furthermore, to emphasise its work during 1952 twenty-six research reports were issued to member firms, ten papers, based upon data obtained from the Association's researches, were read before the technical institutions and three other reports appeared in the columns of the technical press.

During the year the second machine at the Glengarnock testing station was completed and a programme of research on full size built-up structures commenced. With the station fully operational a number of representatives of the technical press were afforded the opportunity to inspect the establishment and to see the machines and some of the work in progress. The Structural Research Establishment at Glengarnock was described and illustrated in our issue of November 7, 1952.

The safe launching of a ship is apt to be taken for granted but accidents do occur on occasion and a number of the unknown factors form a suitable subject for research, so that work has been undertaken to provide data for designers to use in launching calculations. Among the early subjects was the question of the initial forces met by the launch triggers and to study this problem some tests were carried out on the launchways of John Brown and Co., Ltd. Certain tests were also carried out in the laboratories of the Mechanical Engineering Research Organisation at East Kilbride. Greases were studied but to date only a comparison has been made between the properties of Tallene and those of the mineral launching greases and, as an aid to this study, the staff attended a number of launches for the purpose of taking actual measurements.



Back-to-Back Maag Gear Tests

At Palmers Hill, Sunderland, William Doxford and Sons, Ltd., placed a small laboratory and workshop at the disposal of B.S.R.A. and these facilities were used primarily for the development of electronic apparatus required on ships' trials. Among the instruments developed was a measured mile recorder which transmits the various readings made by the staff into a central recording unit and work was put in hand with regard to the instrumentation required for the Association's research into vibration problems. Plans were drawn up for a programme of research on structures and for this work it is intended to use celluloid models in association with polarised light in order to obtain a more concise idea of where major stresses and strains take place in the ship. This information will be used as a guide to the more accurate placing of gauges in ships and so provide more reliable readings.

Results from the "Lucy Ashton" experiments stimulated the already active interest in ship model correlation. Although naval architects and shipowners have always appreciated that hull roughness affects resistance, the actual extent of this, as revealed by the "Lucy Ashton" trials, occasioned surprise. Before a reliable prediction of resistance, based on model results, can be made the condition of the hull has to be assessed. Due to the increased use of welding since the war, the nature of the hull surface has undergone considerable change and an examination was put in hand to assess and evaluate the effect of this change as a basis for predicting ship performance from model results. For this reason the B.S.R.A. continued the programme of loaded trials during last year as a matter of urgency and wherever possible the surface roughness of hulls and propeller blades was measured. At the N.P.L. corresponding models were run and added to the total of information which is being built up with the object of establishing a prediction factor.

An Association report dealt with the modified Farnboro electric indicator, which makes use of the movement of a flexible diaphragm to initiate signals to an electronic relay to cause time and pressure to be recorded. The instrument was developed for determining the mechanical efficiency of large marine oil engines. A full abstract of the report, together with drawings and circuit diagrams, was published in THE ENGINEER on July 4th and 11th last year.

Turning to the problems related to propelling machinery, the construction of the two single-cylinder, opposed-piston, experimental two-cycle diesel engines was completed by Vickers-Armstrongs, Ltd., at Barrow, and the first trials of the engines, as distinct from experimental work, were put in hand. While the engines were building preparations were made in readiness for the research programme in scavenging, instruments to be used were tested, a survey made of all existing information on scavenging, and a report compiled on the effect of back pressure on engine performance.

To simplify the conducting of acceptance trials, especially under conditions of poor or even no visibility, the Association developed a radar device for accurately measuring the ship's speed over the measured mile. This apparatus consists of a unit which is connected up with the ship's plan position indicator and has the effect of showing distance, marked off at mile intervals, on a screen. For the purpose of the speed trial the ship is navigated towards and away from a moored buoy which is fitted with a special radar reflector and the time taken for the ship's image to cover a mile on the screen is photographed against a time base. Trials, during the year, confirmed the effectiveness of the method developed by the Association, and the accuracy of the results when the full photographic method is used.

A paper entitled "Surface Finish of Marine Engine Parts," which was read at the Joint Summer Meeting of the Institution of Naval Architects, the Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution of Engineers and Shipbuilders in 1950 by Professor A. S. T. Thomson, Professor A. W. Scott and Mr. W. Ferguson, gave the early results of the investigation, carried out for the B.S.R.A. by the Royal Technical College, Glasgow, in the various degrees of surface finish specified for marine engine parts. Investigations have continued over the intervening period and they gave rise to a number of reports circulated to members of the Association. One of these dealt with the wear and performance of scraping tools, another was concerned with the different methods of producing a high quality surface finish in mild steel, and a third reviewed the honing practices currently in use in a number of marine engineering workshops. Such work is an example of an investigation, without any fundamental aspects, which gives results capable of immediate practical application.

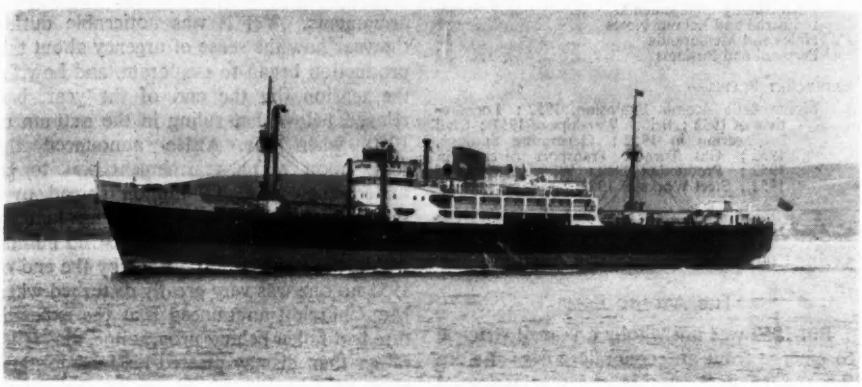
Through the medium of the work undertaken for the B.S.R.A., the Royal Technical College has not only done something of industrial value, but has trained students with an insight into both research technique and the problems of industry. Another item developed by the College is an instrument for determining the proportion of oil contained in the condensate from a reciprocating steam engine. This development was an essential preliminary for another research item in the B.S.R.A. programme, which has as its object the prevention of cylinder lubricant entrained in feed water from entering the tubes of water-tube boilers.

Although not forming part of the Association's programme, the opening of the new towing tank at King's College, Newcastle upon Tyne, during the year, and also the cavitation tunnel, offers opportunities for research to students. The tank, which is 130ft long by 12ft wide, and 5ft deep, is of sufficient size to allow models up to about 7ft in length to be run at speeds corresponding to those of ocean-going vessels.

Electric, hydraulic and friction couplings used in geared propulsion units were surveyed during the year, but electric drives and torque converters were excluded since they were considered to be substitutes for gearing. For comparison purposes the basis used was the characteristics when used as a clutch ;

flexibility of transmission ; degree of acceptability of misalignment and the transmission efficiency. Progress was made in ship vibration tests and the Association was invited to advise on vibration troubles ; the resulting data were added to that already collected, the source of the information remaining anonymous.

At the Parsons and Marine Engineering Turbine Research and Development Association, at Wallsend, continued progress was made with the various items of the programme under the guidance of Dr. T. W. F. Brown, the director. Although no new buildings were started work progressed in equipping a building already constructed, the Aerodynamics Laboratory, on the ground floor, was completed and the combustion and gas-turbine section on the floor above was well advanced.



Cargo Line Motor Vessel "Ebro"

The main activity of the research department continued to be the full-scale testing of steam turbine machinery for the Admiralty. Consumption, manœuvring and operating trials of "Daring III" machinery were completed and the condenser circulating water temperatures were measured by the thermistor system and the results analysed. Other tests carried out included the measurement of the casing temperatures to trace the source of distortions and to determine the best method of rapidly starting from cold, and the measurement of the relative expansion of the rotors to their respective casings. A considerable amount of work was taken over in connection with the "Y.100" prototype turbine trials, and tests were made on various units before steaming, while investigations were put in hand regarding those modifications revealed as necessary by the trials. A high-pressure and high-temperature turbine and steam brake to operate at 1200 deg. Fah. reached an advanced stage of construction in readiness for tests. Research schemes with respect to components progressed and included work on an experimental condenser, measurement of turbine diaphragm deflections and strains, preparations to test a main steam expansion joint for 300 hours at 1000 deg. Fah. and 650 lb per square inch, and tests on an oil fuel heater.

The back-to-back tests on Maag gearing illustrated on page 18 returned a maximum efficiency of 98 per cent and a coefficient of friction of the gear as 0·03. Following model tests the type "A" astern converter was modified to give a design efficiency of 62 per cent, while work proceeded on the type "B" converter. The load-carrying capacity of the Pametrada disc tester was greatly increased by using copper-plated discs and a similar result was achieved with the Timken tester. Measurements of friction and of heat carried away by the oil were made on bearings and two Michell pad bearings were run in the bearing tester, while further investigations were made on the theory of pitting. Tests to establish the losses and heating incurred when steam was admitted to an impulse wheel operating under off-design conditions were completed, while other test plant was advanced and the design of a high-speed, variable-density cascade wind tunnel was put in hand.

Some progress was made in the Pametrada and B.S.R.A. joint investigation of strain gauges of high stability at temperatures up to 1200 deg. Fah. over long periods and, with regard to microphone calibration, an anechoic chamber and low-frequency duct were completed and over a frequency range of 100 c/s to 500 c/s the sound pressure measurement was constant within $\pm 0 \cdot 25$ db.

Although repetition of successful designs caused a decline in new contracts the increase in completed designs added to the work of the design department since minor modifications called for more detailed investigations. Important savings in fuel result from considering the machinery installation as a whole and the department was asked to assist in the choice of auxiliaries. As a result a simplified version of the mixed-pressure turbine used in land installations was designed for generating electricity, there being no separate h.p. stages and full use is made of all l.p. stages, while a separate group of nozzles enables full power to be developed by high-pressure steam. The change-over to high pressure steam is automatic when low-pressure steam is not available, and, in addition, the turbine has been arranged to drive the boiler feed pump.

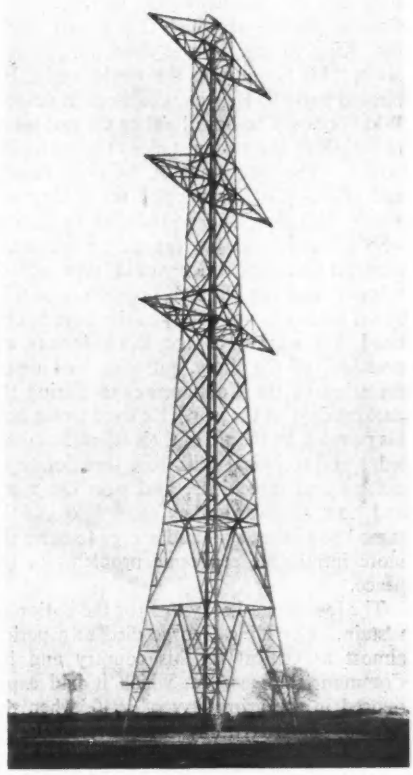
A machinery installation consisting of compound turbines driving through articulated double-reduction gearing to deliver 7500 s.h.p. to a single shaft was designed and at least sixty sets were ordered for the propulsion of oil tankers for the Anglo-Saxon Petroleum Company, Ltd. The all-impulse h.p. turbine has an overhung h.p. stage in a separate casing and the l.p. turbine, of disc and diaphragm construction, has a rotor gashed from a solid forging, giving a better distribution of vibration torque at the one-node critical speed which is of advantage with machinery aft.

The design of the gear grinding machine covered by Admiralty-Pametrada patents reached the manufacturing stage. An investigation of torsional vibration in a twin-screw liner, in which gearing wear occurred, was carried out, and the cause discovered, and this demonstrated the need for a "soft" drive to avoid dynamic magnifications of gearing errors. The failure of binding wires in a naval turbine was investigated and the cause found, while the result of another investigation into trouble experienced by a compound reaction turbine installation driving through single reduction gearing and subjected to rapid manœuvring, illustrated the value of the robustness of modern design. Further developments in turbine blade roots were made and brittle lacquer used to measure local stress distribution. Members of the staff attended the trials of a number of ships and measurements confirmed the estimates of torsional vibration at the first critical speed.

(To be continued)

275kV Transmission Line Towers

THE section of the new super grid now being built by the British Electricity Authority between Tilbury and Elstree is designed to carry double-circuit twin 0·4 square inch copper equivalent, steel-cored aluminium conductors at 275kV, or, if required at a later date, 380kV with modified insulators. The towers for this line have been fabricated by Painter Brothers, Ltd., and the contract for their erection was placed with the J. L. Eve Construction Company, Ltd., of 17, Hill Side, London, S.W.19. The first tower for this scheme was recently completed and is to be seen in the photograph we reproduce below. Erection of the second tower is well advanced, and the foundations have been placed for a further forty-five. Altogether, 217 towers will be required to carry the line the 45 miles between Tilbury and Elstree, the normal span length being some 1200ft.



275kV Transmission Line Tower

The towers will carry two three-phase circuits, there being two conductors per phase arranged horizontally 16in apart, making a total of twelve conductors. A normal straight line tower such as we illustrate is 136½ft high and at the middle cross arm the spacing distance is 37½ft. Each of these towers weighs about 11 tons and the foundations for its four legs are sunk to a depth of some 10ft 6in. The main legs, main cross arm members and some of the bracings of the towers are made of high-tensile steel, the remainder of the members being of mild steel.

THE ENGINEER

Vol. 195 JANUARY 2, 1953 No. 5058

LEADING ARTICLES—

A Retrospect ... 20

ARTICLES—

Aeronautics in 1952. No. I. (Illus.) ... 24
Atomic Energy in 1952. (Illus.) ... 11
Barnstaple Transmitting Station ... 23
Blea Moor Derailment Report ... 1
British Iron and Steel Industry in 1952. No. I. (Illus.) ... 29
British-Built Locomotives of 1952. (Illus.) ... 2
Civil Engineering in 1952. No. I. (Illus.) ... 13
Contemporary Methods of Watch Production. No. I. (Illus.) ... 34
Distribution of Primary Copper ... 1
Electrical Engineering in 1952. No. I. (Illus.) 26
Electrical Engineers' Exhibition, 1953 ... 23
Ewing Medal ... 1
Export of Electrical Equipment to Canada ... 15
Extension of Aircraft Production Priority Scheme ... 1
Gatehead Protective Canopy. (Illus.) ... 36
Labour in 1952. No. I ... 8
Naval Construction in 1952. No. I. (Illus.) ... 31
Professor A. H. Jameson ... 1
Royal Navy, 1952. No. I. (Illus.) ... 5
Shipbuilding and Marine Engineering in 1952. No. I. (Illus.) ... 16
Size of Manufacturing Firms ... 1
Training Course for Foremen ... 1
275kV Transmission Line Towers. (Illus.) ... 19

LETTERS TO THE EDITOR—

Engineers' Guild ... 22
Strain Hardening of Metals ... 23

NEWS AND NOTES—

British Patent Specifications. (Illus.) ... 39
British Standards Institution ... 40
Calendars and Diaries ... 40
Forthcoming Engagements ... 40
Industrial and Labour Notes ... 37
Notes and Memoranda ... 38
Personal and Business ... 38

EIGHT ART PLATES—

Monte Bello Atomic Explosion, 1952; Locomotives of 1952; British Warships of 1952; Civil Engineering in 1952; Generating Stations, 1952; Gas Turbine Transport Aircraft in 1952; Production Delta Wing Aircraft of 1952; Steel Works of 1952.

A RETROSPECT

To look back upon 1952 is to mourn. "Death lays his icy hands on kings." On February 6th, suddenly, this nation and the Commonwealth of which it is a part learnt that King George VI was dead, that he had given "his honours to the world again, His blessed parts to Heaven, and slept in peace." What honours he bore! They did not reside in the pomp and circumstance of monarchical power. They grew out of the deep respect and affection of his peoples for a king and a man who came unexpectedly to the throne, who suffered from, but valiantly overcame, a physical disability which would have unfitted a lesser man for his high position, and who stood unshaken not coldly as the mere figurehead, but warmly as the living human expression, of the unity, purpose, and determination of the Commonwealth during the darkest days of the war. He lived to see how his peoples, by the aid of their scientific knowledge and technical skill, rose superior to all defeats and difficulties, and won the war; and how afterwards they started to use the same knowledge, skill and energy to solve the more intractable economic problems of the peace.

The loss was a heavy one for the nation to sustain. For King George died at a period almost as critical for his country and his Commonwealth as that which it had experienced in the grim days of 1940, when the tide of Nazi tyranny was overwhelming France and the flower of Britain's Army seemed trapped upon the beaches of Dunkirk. Upon a cold calculation no one could be sure last February that actions already taken by the Government could stave off the national bankruptcy that threatened as the draft upon the central reserves of the sterling area continued. Imports had, indeed, been cut back. But the Budget was still to come, there was a heavy defence production programme to maintain, a steel shortage was already apparent, and other raw materials were still very scarce. While the air was yet full of mournings for the dead and greetings for a new young Queen Elizabeth, called upon unexpectedly early to fulfil her destined role, the people of Britain had to return to work as usual, to the task of saving themselves by their own exertions.

THE ATOMIC BOMB

But 1952 was not wholly a year of struggle to emerge from an economic crisis. Before the end of it there was given to potential enemies a stern reminder that, even under the handicaps of the economic situation, Britain's scientists and engineers were no whit inferior to others in acquiring knowledge and but little behind others in making use of it in the production of new weapons of war. In October there was exploded amongst the Monte Bello Islands an atomic bomb made in Britain and designed by British scientists and engineers without the help of American "know-how." It did more than give notice to potential enemies that Britain and the Commonwealth had became a force to be reckoned with in atomic warfare; it did more than provide for Britain's engineers and scientists, officers of the armed forces, and civil defence workers information about the effects of an atomic explosion. It also gave notice to the Americans that they could no more conceal from their Allies and friends than they could from potential enemies beyond the Iron Curtain the production processes necessary for the making of atomic weapons. It emphasised how short-sighted had been the passing by the American Congress of the Atomic Energy (or McMahon) Act of 1946, an Act that brought to an end the former co-operation between the nuclear scientists and engineers of Britain and the Commonwealth upon the one hand and of America on the other, debarred Commonwealth scientists from participation in tests of American weapons and equally debarred American attendance at the Monte Bello Islands. That Act was passed in a mood of nervousness and under the erroneous belief that secrecy to prevent Russians discovering the techniques of atomic bomb production must be extended also to Allies. Secrecy overreached itself. It did not prevent the Russians producing the bomb. It merely prevented the more rapid advances in techniques of design and manufacture that might have been brought about by collaboration between Allies; and it severely hindered the development of strategic and tactical thinking amongst the Service personnel of members of the N.A.T.O. countries that would have been the fruitful consequence of a more liberal attitude. In this New Year a new administration takes over the duty of guiding U.S. policy. The bursting of a bomb amongst the Monte Bello Islands will induce new thinking in the United States.

DEFENCE

But the atom bomb by itself is an incomplete defence. For more complete protection a country needs conventional weapons as well, and during 1952 a great deal of effort and a great deal of industrial productive capacity was devoted to the making of armaments. Yet it was noticeable during the year how the sense of urgency about this production began to evaporate, and how far the tension, by the end of the year, had relaxed below that ruling in the autumn of 1950, when Mr. Attlee announced the scale upon which rearmament was to be undertaken, at £3400 million spread over three years, and in the following January raised the bid to no less than £4700 million within the same period. Even by the end of 1951 no one was very greatly disturbed when Mr. Churchill announced that the expenditure had fallen behind programme, and relief rather than dismay greeted his further statement only last month that there were to be changes in the programme, that production was to be spread over five years instead of three, and that the rate of output would not rise to a peak in 1953, but would be levelled off. That relief stemmed from two causes. One of them was that arms contracts have seriously affected the ability of engineering firms to quote early deliveries even for export business. A slowing down of war production may permit them more satisfactorily to meet rapidly growing foreign competition for orders and to increase exports. The other arose out of the conviction that the present—a time when new rocket, atomic and other weapons and devices of war and new subsonic and supersonic military aircraft are under rapid development—is not a good period in which to pile up more than a minimum safe margin of armaments that might very well prove obsolescent almost as soon as war broke out. If it becomes necessary for this country to fight another war—which God forbid!—it is much more likely to be a long one than a short one. It will be available productive capacity and the technical skill to bring into early use new weapons then in a late stage of development that will turn the scale rather than a mass of more conventional existing armaments. In fact, the war potential of Britain resides more in the skills of those who are designing and developing new swept-wing, scimitar-wing and delta-wing aircraft, studying the potentialities of atomic weapons, and examining the characteristics of guided missiles than in the possession of a great stock of arms.

PEACETIME PRODUCTS

But let us turn from sombre thoughts of "wars and rumours of wars." The primary task of engineers is not to devise machines and weapons with which cities, industries and men can be destroyed, but to build up the world's production, to improve its transport, to raise standards of living, to make a

better and more complete use of the resources Nature provides and to bring material blessings, not curses, to the human race. In those fields 1952 was a fruitful year, as reference to the many articles in this and following issues will show. For it was not only new fighter and bomber aircraft that impressed visitors from all over the world at the Farnborough show, but the leadership of the British aircraft industry in the design of civil aircraft, too. It was not only the Admiralty that could announce the use of gas turbine engines at sea in the " Grey Goose " and certain motor vessels, and the development of gas-turbine-driven auxiliaries. Particulars became available of the performance of a gas turbine engine during Atlantic crossings by the tanker, M.V. " Auris," and a great deal of work was being done on the development of gas turbines for civil purposes. Machine tools are needed for armaments production. But the fine exhibition organised by the Machine Tool Trades Association at Olympia demonstrated how superbly British machine tools are designed for high productivity in British and oversea civilian factories and how endlessly improvements are being made in them. In civil engineering further progress was made, amongst other matters, in the understanding and use of prestressed concrete. Indeed, our columns week by week recorded not only such events as the commissioning of great new power stations, the launching of new ships, the production of new locomotives, the building of dams and the improvement of harbours, but the production of a host of lesser things as well, all of them tributes to the energy, ingenuity and inventiveness of engineers. We ourselves had a contribution to make. In August, through the adoption of " Times Roman " type, we made this journal easier to read.

Productivity

Yet behind all this technical activity engineers continued to be troubled in mind by much the same problems that have beset them ever since the war ended. The greatest of those problems, to which all others are in some sense subsidiary, is that of raising productivity. Much was written and said upon the subject ; many conferences were held ; the flow of Anglo-American productivity reports continued to emphasise that productivity in America seems higher in every field than it is here. Yet—dare we suggest it?—much of this activity seemed to be degenerating during the year into mere nagging, the perpetual repetition *ad nauseam* of truths, already widely accepted as truths, to the long-ago converted. The work of raising productivity needs now to be pursued upon the shop floor. It should become the domestic concern of each industry, each factory, each shop, and each man. For there the principles of productivity can be applied to real production problems. There they can be usefully discussed in really practical detail. Only at that level can the subject of productivity any longer continue to generate a real and useful enthusiasm. In more than one industry, fortunately, the consideration of productivity has been carried so far down, notably in the steel founding industry, the first to send a productivity team to the States. There, to judge by what was said at a Press conference just before Christmas, results of real value are being obtained by interesting men from the shop floor itself in discussions that can affect their own and their neighbours' rates of output. They may eventually break down prejudices against, for instance, time and motion studies, and the fear, bred of unemployment between the wars, that improved productive methods necessarily mean fewer men at work.

During the year the Anglo-American Council on Productivity was wound up. It had, indeed, done its work. Altogether, when the publication of the reports of teams that visited America has been concluded, some sixty-six will have been issued. They form a remarkable survey of American productive methods, and their stimulus to improvement in this country's industries has unquestionably been immense. Yet it remains as true as ever that British industries should be careful not to model themselves too closely upon American ideas. Primarily, American industries make for their own home market and that home market, though its desires are indeed varied, is still astonishingly homogeneous for an area continental in proportions. A small concern starting up with the intention of supplying a small locality can, from the beginning, " think big." For if a product sells well locally it is probable it will sell well over a very much wider region. It pays to " think big " in America. If quotas and tariffs could be eliminated within Western Europe and the Commonwealth it might, equally, pay to think as big in Britain. But British firms must make the best of the economy in which they dwell and the very varied and far from homogeneous world markets to which they sell their goods. That does not mean that high productivity should not be sought or is not worth seeking. It does mean that the methods employed cannot invariably be those appropriate in America. The means must be adjusted to the circumstances. High productivity must be sought without necessarily and always associating it with high production, and without necessarily carrying specialisation and simplification so far as they have been carried in America. Moreover, within the strait-jacket of Britain's economic difficulties it must be sought as much through the better and more intensive use of existing plant as through the installation of new. The British Productivity Council which came into being during the year will have much to think about.

Fuel and Power

Out of sight often means out of mind. In every year since the war until 1952 the winter has been begun with stocks of coal too low to relieve anxiety about the possibility of shortages in the spring ; and always there has been the threat and usually the actuality of power cuts, to reduce industrial output during the winter. The year 1952 turned out to be an exception. Quite early it became obvious that coal stocks would build up to satisfactory levels during the summer and that more than usual could be safely exported; and in the autumn less restriction upon the use of electricity was necessary. But the apparent improvement was unreal. The output of coal during 1952 only exceeded that of 1951 by about 2,700,000 tons ; and though more than 1,200 MW of new generating plant was commissioned electricity generating capacity is still probably very far below the maximum demand that could be placed upon it. A false sense that the problems of meeting, in full, demands for fuel and power were being overcome was generated by the fact that certain industries, notably textiles, experienced a sharp though temporary recession during the year, whilst the activity of others, such as engineering and shipbuilding, was held back by shortages of raw materials and particularly steel. Demands for fuel and power consequently fell.

It was unfortunately under those circumstances that the report of the Ridley Committee on " National Policy for the Use of Fuel and Power Resources " was issued. It appeared at a time when the continuing urgency of the subject was no longer very apparent ; and as compared with the expectations of some commentators that it would prove very critical of lack of co-ordination between nationalised industries and of others that it would have dramatic proposals to make in order to conserve coal, it proved quite unsensational. The truth, no doubt, is that short of legislation so severely compulsory in character that no democratic politician would care to suggest it, little can be done directly to set going a national policy. Persuasion rather than compulsion must be relied upon. Industry must be " educated " in the advantages of fuel economy ; and reliance must be placed upon the suasion of minor alterations in taxation and in price to encourage the installation of economical domestic grates and to discourage particular uses of electricity or fuel that are wasteful. Even so, it is far from easy to assess the true economic costs of competing forms of heating and power, as the Committee itself discovered. As for the rest—the building of power stations on the coalfields, the electrification of railways, the larger-scale gasification of coal, underground gasification, and many other proposals designed to conserve coal stocks—their rate of realisation is very largely controlled by economic circumstances and the amount of capital available. All of those proposals are being studied and some progress was made during 1952 towards the realisation of some of them. Less notice, therefore, than might have been expected was attracted by the Ridley Report. But if, as is by no means impossible, should industrial output resume in 1953 the rapid upward trend of earlier years, the country is once again troubled twelve months hence by serious shortages of fuel and power, renewed attention is likely to be given to it.

Research and Education

As part of that process of self-criticism to which, rightly, the nation has been submitting itself industrially since the war, scientists continued to preach during the year that engineers fail or take too long to apply scientific discoveries in industry. It certainly is deplorable that a number of British scientific discoveries in the past were put into practice abroad before they were used industrially in Britain. But in the ears of engineers much of what scientists say upon the subject smacks of lack of knowledge of the engineering process and of industrial conditions. As inventors times out of number have discovered, it is one thing to have an idea or even to make a working model ; it is quite another to work up the idea into something that not only

operates satisfactorily upon the full engineering scale but also can compete successfully in cost with existing devices or processes. The engineering attitude to this problem is significantly different from that of the scientist as becomes apparent as soon as engineers like Sir Ewart Smith, who recently addressed the Parliamentary and Scientific Committee about it, talk upon the same subject. The emphasis immediately falls upon production. The need is felt to improve products and to increase the rate at which they are produced. What scientific knowledge, the engineer asks, is available that could be applied for those purposes ? It is realised that there is a lack of men in industry trained to appreciate how scientific discoveries could profitably be applied in that way.

For long this country has played a leading part in fundamental research and it continues to play it. Its contributions to technological research have been of no mean order and its organisation for extending that kind of research has been subjected to rapid expansion since the war. Hardly a year has passed without the need for this journal to record the starting of work upon or the inauguration of new research laboratories or the extension of old ones, and 1952 was no exception. But it is the link between research establishments and industry that is subject to criticism. Industry —though rather less particularly the engineering industry—seems short of men who can talk with and understand scientists and applied scientists, and who can, with their co-operation, see how and where to apply their discoveries to the practice of design and in production. It is to train such men that it is so often proposed that provision should be made for a specifically technological education as opposed to the more fundamental education given by existing university courses. The late Labour Government proposed to set up a non-teaching award-making body under the title of the Royal College of Technology to encourage courses of the desired character at technical colleges. That proposal was much criticised and the present Government announced during 1952 that it was to be dropped. Instead there is an intention to build up " at least one institution of university rank devoted predominantly to the teaching and study of the various forms of technology " and to make improved financial assistance available to selected technical colleges. But as no more detailed proposals were issued during the year it would be profitless, as yet, to offer any comment.

Transport

If the industrial output of a country is to be high it must, obviously, be blessed with an adequate and efficient transport system. When in 1947 the late Labour Government nationalised transport it did so not only from the " doctrinaire " conception that so basic an industry ought to be within public ownership, but as much out of a belief that by ending road-rail competition and by bringing all transport under the control of a single Commission, a truly co-ordinated system could be built up more efficient than that formerly existing. The project proved only partially successful, and the existing Conservative Government, as a consequence of a series of beneficial modifications of its original intention of merely restoring the *status quo*, introduced last year a Transport Bill differing fundamentally from the socialistic measure. It is based upon the contrasting conception that only the compulsive urge of competition can inspire high efficiency and consequently it is designed to restore road-rail competition. The better to fit them to meet road competition the railways are to be relieved of certain restrictions originally imposed to protect traders when they had a virtual monopoly of inland transport. But interesting and constructive as that measure proved to be, it encountered much criticism even from friends of the administration. The levy it imposed upon road transport was disliked ; the advantages of the decentralisation of railways into autonomous regions were doubted and the advisability of breaking up the Road Haulage Executive's fleet of vehicles into numerous small privately owned " transport units " was called in question. Moreover, it was increasingly held during the year that party political argument about the organisation of transport was largely irrelevant. Little enough capital is being spent upon the improvement of railways. But hardly any is being spent upon roads that are unsuited to carry present-day traffic and are likely to prove even less adequate to bear the increased traffic of the future. Those were points forcibly made by Mr. Brunner in his presidential address to the Institute of Transport in October. Whatever the organisation of transport is to be it cannot prove efficient unless more capital is spent upon improvement.

Iron and Steel

The Iron and Steel Bill presented to the House during the year proved, as expected, to be a workmanlike measure designed to replace the Iron and Steel Corporation by a supervisory Iron and Steel Board and to set up a separate selling agency to take over and dispose of the Corporation's assets to private enterprise. Though the Socialist opposition thundered against it, so ample a supervision of the industry is conceived that there is hope the measure will receive, if and when it becomes an Act, the tacit assent of that opposition. If so, the iron and steel industry, which was producing steel by the end of the year at a rate higher than it had ever achieved before and which was busily planning further extension and rebuilding of its plants, may at long last cease to be the subject of party political controversy.

The New Reign

" What's past is prologue." It is not difficult in the present year to find an excuse, after scanning the past, to review the future. For in 1952 a new reign began and this year a second young Elizabeth will be crowned at Westminster. What are the prospects her reign holds out for the Commonwealth and this country, which is a part of it ? In the immediately coming years the Commonwealth, undoubtedly, will be engaged in a struggle to improve its economic situation, a struggle in which engineers will play a large part by developing its huge potential resources of primary products as well as by providing the power and machinery for extending secondary industries. At home a different problem urgently requires solution. During the past year evidence piled up that heavy taxation combined with conventional accounting methods is making it virtually impossible for many industries even to maintain real existing assets, let alone set aside reserves to provide new capital equipment. That is an intractable problem with which in coming years successive Chancellors of the Exchequer will have to struggle. For all political parties are agreed upon the desirability of maintaining the " Welfare State " ; yet it is hard to see, without tampering with welfare provisions, how taxation can be reduced. But if the short-term prospects for the new reign are, thus, rather bleak and even though there are sombre possibilities that it might be marred by a third and much more terrible world war, the longer-term prospects are much more exciting. Within what all hope will prove a long and eventually prosperous reign, who knows what engineers may have achieved ? Certainly the gas turbine will have found itself in applications to which it is particularly suited. Perhaps before the reign ends ordinary passenger aircraft will fly at supersonic speeds. The uses of nuclear energy seem at present restricted. But who knows what the continued intensive research of atomic physicists will bring forth that engineers can apply ? And is it not possible that engineers will have made a real start within Elizabeth's reign upon an adventure more exciting than any man has yet undertaken ? It is already far from fantastic to set about the design of a high-speed rocket of which a part could be thrown clean off the earth or to contemplate the setting up for scientific purposes of artificial satellites to this planet. Before the end of the present reign the R.A.F. motto " Per Ardua ad Astra " may have begun to win a new and more literal meaning. Within this new Elizabethan age Man may have begun the exploration, in person, of the Solar System !

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE ENGINEERS' GUILD

Sir,—Mr. K. H. England, in your issue of December 12th, doubts if the Guild can achieve its objects while adhering to its policy of restricting membership to members of the three senior institutions. The answer is very simple. The Guild is achieving its objects. The unity, public usefulness, honour and interests of the engineering profession are being steadily enhanced.

J. H. W. Turner
Honorary Secretary,
The Engineers' Guild.

London, S.W.1,
December 22nd.

Sir,—I think that Mr. K. H. England is incorrect in the premises of his argument as expressed in his letter published on December 12th.

The Engineers' Guild is an association of professional engineers. This is expressly stated in the constitution, and rightly so. If Mr. England's suggestions were to be adopted the constitution must be amended and a new title found for the Guild. It can be agreed that there are senior members of the profession who do not enjoy corporate membership of the major institutions; it cannot be agreed that senior administrative officers who may not enjoy corporate membership of these institutions are members of the profession. Nor can financial considerations deter potential membership of the kind and quality envisaged by Mr. England.

There are good managers and bad, both in

the profession and outside it, and, as Mr. England points out with unnecessary emphasis on one side, professional qualifications or the lack of them have little bearing on the outcome. I believe that there are some half dozen associations or institutions which cater for the executive who is not a professional engineer, some of which associations have more freedom than is permitted by the charters of the major engineering institutions.

W. GRANT
B.Sc. (Eng.), A.M.I.Mech.E., A.M.I.E.E.
London, S.E.4,
December 23rd.

THE STRAIN HARDENING OF METALS

SIR,—The publication in your issue of November 21st of Professor Mott's stimulating lecture on the work hardening of metals prompts me to offer a few remarks which may be of interest to your readers.

Professor Mott seems inclined to think that the stress-strain relationship for materials which work harden is, or should be, parabolic in form. Though I have analysed very many strain hardening curves, I have never yet encountered one which was a parabola. Over limited ranges of plastic deformation some of them approximate to power functions with indices other than 2, but when extended to embrace both large and small strains, double logarithmic plots invariably give curves shaped like an elongated "S." Apparently the almost straight portion in the middle has lured many authorities into acceptance of the power relationship. Experience has convinced me that the strain hardening function is basically exponential, and that the equation is essentially that which I proposed in 1948 (*J.*, Inst. Metals, Vol. 74, page 537). Since that date I have found that deformation generally takes place in two successive régimes with the same equation, but with different constants. As the régimes merge tangentially into each other there is no discontinuity at the transition point.

The exponential function can be deduced very simply from the picture which Professor Mott presents in his lecture. He visualises the existence within the unstrained metal of a large number of minute sites at which resistance to deformation can be created as deformation proceeds. Any infinitesimally small increment of strain may lead to the blockage of one of the sites, or it may not. If it does so, the resistance to further deformation is slightly increased, and the metal is correspondingly strain hardened ; if it does not, little or no strain hardening takes place. Professor Mott identifies the virgin sites with "Frank-Read sources" and the blocked sites with "sessile dislocations" ; but, because the argument which follows is not necessarily dependent upon the dislocation theory, I prefer to use less restrictive phrases.

Let the total number of strain hardening sites in a piece of metal under test be N, and let n be the number of those which have become blocked after the application of a natural (logarithmic) strain η. Assuming the sites to be randomly distributed, the chance that a minute increment of strain occurring anywhere within the metal will give rise to a new blockage is proportional to the number of sites still remaining to be blocked, namely $N-n$. Consequently

$$\frac{dn}{d\eta}=\frac{N-n}{\eta_e} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where η_e is a constant of proportionality in logarithmic strain units. Integration between zero and η strain leads to

$$\frac{n}{N}=1-\exp\left(-\frac{\eta}{\eta_e}\right) \quad . \quad . \quad . \quad . \quad (2)$$

On the average each blockage will contribute the same tiny quota to the stress which is required to deform the metal. It follows that the ratio of blocked sites to total sites, n/N, is the same as the ratio of the current (plastic) stress to the final stress attained after all the sites have been blocked. Therefore

$$\frac{n}{N}=\frac{S-S_o}{S_\infty-S_o} \quad . \quad . \quad . \quad . \quad (3)$$

where S is the current yield stress, S_∞ the yield stress attained after all the available sites have been blocked, and S_o the original yield stress of the material, or threshold stress below which strain hardening does not occur. Combining equations (2) and (3),

$$S=S_\infty-(S_\infty-S_o)\,.\,\exp\left(-\frac{\eta}{\eta_e}\right) \quad . \quad (4)$$

This I believe to be the basic strain hardening function. It agrees excellently with experiment from a point a little above the limit of proportionality upwards for a very considerable range of strain. Thereafter it continues, in the absence of disturbing factors such as the triaxial stresses associated with the necking of a tensile specimen, under a second régime with different constants. Whether the change of régime is attributable to the advent of an entirely different mechanism or to mutual interference of the accumulating blockages remains an open question. However, when both curves are computed from their respective constants for the entire range of strain from zero to infinity, it is invariably found that at any particular strain the favoured régime is that for which a given increment of hardness (yield stress) can be obtained for a lesser expenditure of work, i.e. that for which the work hardening process is the more efficient. This suggests that we are concerned with two independent mechanisms, a conclusion which is consistent with modern views on strain hardening.

E. VOCE, M.Sc., Ph.D., F.I.M.
Senior Metallurgist,
Copper Development Association.
December, 1952.

Barnstaple Transmitting Station

THE British Broadcasting Corporation states that on December 11, 1952, the new permanent transmitting station at Fremington, between Barnstaple and Bideford, took over the West of England Home Service on 285m (1052kc/s) from the temporary transmitter which has been operating from a caravan on the site. It is one of a number of low-power stations being built to improve reception of the Home Service in certain areas. The new transmitter, which is of higher power than the caravan transmitter, will extend the area of improved reception beyond the immediate surroundings of Barnstaple and Bideford to include outlying districts such as Northam, Great Torrington and South Molton.

The equipment, housed in a building some 14ft square, is designed for completely automatic operation without the attendance of staff. It comprises two Marconi transmitter units working in parallel to give an output of 1¼kW. Later a third transmitter unit will be added, increasing the total power to 2kW. The outputs of these units are paralleled by means of a specially designed r.f. hybrid-coil combining circuit which is arranged to prevent any interaction between them, and their combined output is fed to a T-aerial supported by two tubular steel masts, each 126ft high.

Main and reserve crystal controlled drives are provided, and automatic frequency control equipment will shortly be installed which, using the Droitwich 200kc/s carrier as a reference, will maintain the transmitter drive frequency within very close limits of accuracy.

As the station is to be unattended provision has been made for automatically checking the quality of the incoming programme and the radiated programme, and taking appropriate action in the event of a fault. The incoming programme is checked by an automatic line monitor, designed and developed by the B.B.C., which compares the programme applied to the transmitter at Barnstaple with coded information sent over a separate circuit from Bristol whence the programme emanates. Thus, the monitor is able to check line noise and frequency response and, if a fault is observed, its first action would be to change over to a spare set of programme input equipment. If the fault was not cleared by this step, the programme to the transmitter would be interrupted, but it would be restored later if the monitor had observed the incoming programme to be trouble-free over a predetermined period.

Parts of the monitor equipment at each end of the line are duplicated. If one section at the sending end fails, a local alarm is given and a "safe" signal is automatically sent to line which prevents the station equipment at the receiving end of the line taking executive action. If one section at the transmitting station failed, the second set would automatically take over and, if it too failed, the station would be closed down. Means are provided to prevent any unnecessary interruption of the service due to minor faults that would not appreciably affect the programme heard by listeners.

Further automatic monitoring equipment supervises the performance of the transmitting equipment itself by comparing the programme fed to the transmitter with that being radiated. Each transmitter unit is fitted with a monitor which checks the input against the output before the latter reaches the combining circuit, and, in the event of a fault in one of the transmitter units, it would be automatically disconnected, leaving the station running on reduced power. Should further faults occur, the affected transmitter units would be closed down by their respective monitors.

To allow the engineering staff at the parent centre at Bristol to obtain information regarding the condition of the equipment at Barnstaple a telephone indicator device has been installed. A telephone call to the station will cause this equipment to send to line a series of coded tone-pulses—similar to those used on an automatc telephone system for indicating "dialling," "ringing" or "number engaged." From the particular tone code heard the engineers can determine the state of the various items of equipment at the station. Such calls are made as a matter of routine during programme hours, so that if necessary an engineer can be sent, in advance of the regular monthly maintenance visit, to prevent a fault developing.

Power for operating the station is drawn from the South Western Electricity Board's 415V, three-phase, 50 c/s network and an automatic voltage regulator is provided to maintain the supply voltage to the transmitters and other equipment constant despite variations in the incoming supply pressure.

Electrical Engineers' Exhibition, 1953

THE Electrical Engineers' Exhibition, the second to be organised by the Association of Supervising Electrical Engineers, will be held at Earls Court, London, from March 25th to 28th, from 10 a.m. to 7 p.m. Among the exhibitors will be the British Electricity Authority, the Electrical Research Association, the British Electrical Development Association, and more than 100 manufacturers. The exhibits will include equipment for lighting, heating, cooking and power requirements, and switchgear, transformers, motors, cables, relays and meters will be on show. Illumination and commercial cookers will be prominent among the exhibits and lighting equipment ranging from single gas-filled lamp fittings to multi-fluorescent-lamp assemblies will be displayed. Further particulars can be obtained from the secretary of the Association of Supervising Electrical Engineers, 54, Station Road, New Barnet, Herts.

A RUST-PROOFING PROCESS.—When metal parts are dipped in rust preventative solutions it is possible to trap any damp on their surfaces beneath the protective coating of oil. For this reason a new solution has been introduced by Tool Treatments (Chemicals), Ltd., Colliery Road, West Bromwich, which is designed to dislodge any damp or water from parts and apply a protective coating of lanolin. For use with this new rust preventative a treatment tank has been developed by the firm and in this tank the water automatically displaced sinks to the bottom, whence it can be easily drained from the solution above. Articles after having been dipped can be placed on a perforated rack at the side of the tank to drain off any surplus liquid.

Aeronautics in 1952

No. I

Civil Aviation

Of the several distinct phases which can be distinguished in the evolution of the flying machine none is so clearly defined as is this present one where, with the advent of the gas turbine, the characteristics of profile and performance of present aircraft have been so suddenly transformed and their future made so unpredictable. For in recent years so rapidly have the limits of theoretical and even practicable attainment appeared to recede—especially in the light of other heat engine developments owing much to the gas turbine itself—that the mind seemed unable to recognise any absolute boundary to this advance or any barriers likely to cause more than transitory checks. One is tempted even to regard the significance of these present trends as comprising a challenge more momentous, of equal hazard, and of greater scope than was presented to those other pioneers who, at the birth of this century, were the first to go aloft in powered flight.

Of the present evolutionary trends, that barrier which administered the first check comprised the effects of compressibility on the airframe at high subsonic speeds and restrictions primarily of a metallurgical nature on the propulsive unit. Together these factors have imposed on jet-propelled civil airliners, if not as yet an agreed profile, at least a fairly defined limit of cruising conditions, which might well prove to be the optimum for many years—an era of long range aircraft with cruising speeds upwards of 500 m.p.h., finally approaching 600 m.p.h. at heights between 40,000ft and 60,000ft, and capable of flying non-stop between the principal cities of the world.

What more completely exemplifies this stage—a stage emerging particularly clearly last year—is an aircraft with a name which must always recall this period—the "Comet." The "Comet," made by the de Havilland Aircraft Company, Ltd., is the first and only civilian airliner to join the world's air routes powered by jet propulsion, and it is likely to remain so for several years. It has now been on scheduled services since last May. With it this country established a world lead in aeronautical design more complete than it had been the fortune of any other nation to secure since flight became a commercial proposition. The inaugural flights last year, only five and a half years after the basic design had been settled, stirred the imagination of the whole world, for in that period the difficulties and diverse engineering problems which faced the designers had been well and freely admitted in most lands.

One of the important issues therefore being discussed at the time of the S.B.A.C., Farnborough, display last year were the production plans by which this country hopes to maintain its present lead, in face of the competition which it must undoubtedly experience from America in the distant future, who, once it is her mind and knowledge to produce jet airliners, will produce a lot.

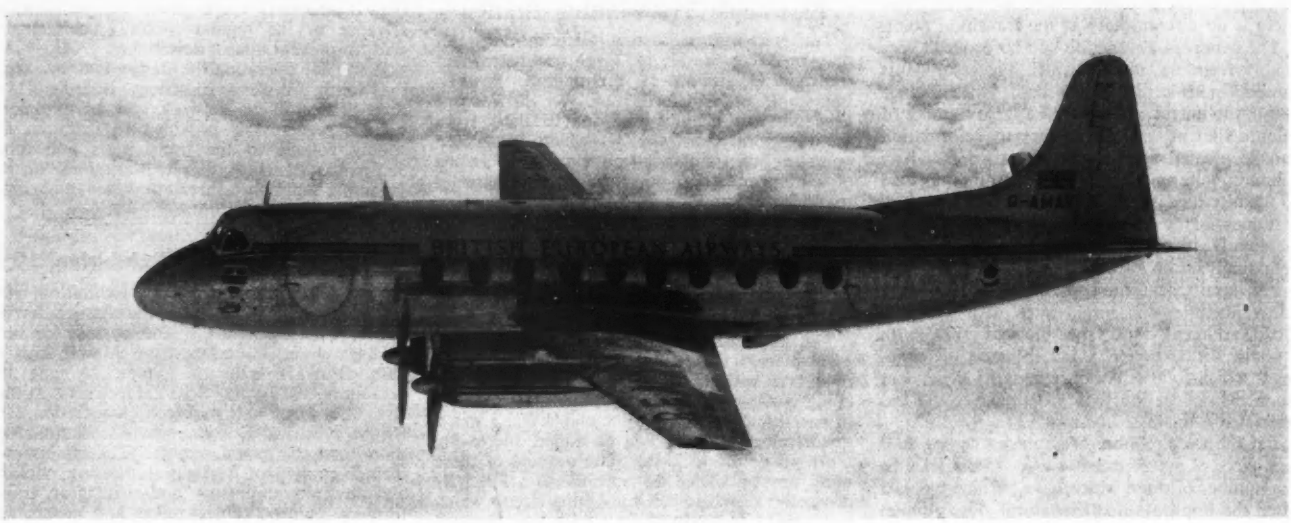
It is perhaps pertinent at this stage to ask why America in view of its research facilities and vast material and skilled labour resources, should have allowed the focus of world civil aviation interest to slip so completely from that land where, since the 1930s and the "Dakota" aircraft, it had rested so securely. It is stated by some that, on the one hand, being so committed to the large-scale production of superior aircraft of conventional design, it was not in her interest to promote the development of jet aircraft. On the other hand, so many were the genuine problems when the "Comet" was conceived in 1946, involving factors of which the influence was unknown and many more about which barely a measure had been obtained, that it is conceivable the Americans were persuaded to overestimate the difficulties and underestimate our resources if not our ability also to solve them.

There are others, however, who do not overlook the fact that America has obtained considerable flying experience on supersonic flying machines and rather than dissipate her resources on interim aircraft is poising herself for the launching of supersonic passenger machines. However, the jump to clearly supersonic speeds—and such a step it must be because of the impracticability of flight within the transonic region—is not conditioned by the attainment of suitable airframes and engines alone. Discounting the manner in which these problems may be resolved, there remain the equally formidable problems relating to the operation of very high-speed aircraft in a mixed traffic pattern, where even high subsonic aircraft tax existing world radio and navigation aids to their limits, and find meteorological services inadequate.

It seems highly probable, therefore, that the limits satisfied by the "Comet" series and later machines whose development has already been intimated will persist long enough to justify the consolidation of this phase in aeronautical development. By maintaining its present lead in both engine and airframe design, this country would furthermore gain much valuable operating and manufacturing experience, some of which there is reason to hope will apply eventually to the truly supersonic machine.

American reaction to the world's acclamation of the "Comet" last year seemed confused. It is reliably reported, in fact, that one controversial figure in that country dismissed the situation by inferring that as this country had generally declined and was insistent on a short working week, it was not likely to produce such aircraft in anything like significant quantities.

Nevertheless, the whole question of producing in sufficient quantities the turbo-jet and prop-jet aircraft in this country, especially in view of its military commitments, had given cause for some concern. Towards the end of last year, however, statements by the companies concerned helped to clarify both the demand and supply envisaged. That very real labour problems and others affecting production technique certainly exist, was evident in the discussions at the recent productivity conference of which a brief preliminary report was included in our last issue.



The Vickers "Viscount"

Civil Aircraft

One of our illustrations shows the Vickers "Viscount," the first propeller turbine airliner, which has four Rolls-Royce "Dart" engines, each developing 1400 b.h.p. plus 365 lb static thrust at sea level. The "Viscount" is at present being manufactured at the works of Vickers-Armstrongs, Ltd., Weybridge, where the first production aircraft have already been completed. This production is being augmented by the company's works at Hurn, where arrangements are already in hand for production at a rate

of 100 aircraft per year. This production compares with the production of 109 twin-engined piston airliners in the United States in one year, which is believed to be a world record.

The latest order for fifteen of these machines constitutes the largest single dollar order for any commodity, which is both made and assembled in Britain, placed with a British company since the end of the war. The value of this order is about £4,100,000. Deliveries which will begin in September, 1954, are to be completed by April, 1955, and the company states that such delivery dates should dispose of the impression that "Britain can never produce the excellent aircraft she designs." These fifteen machines will be operated by Trans-Canada Air Lines. They will carry forty-eight passengers and will be used to supplement the existing T.C.A. fleet on inter-city services, and to link the cities in the Montreal-Toronto-New York triangle and on the route between Toronto and Chicago.

Although a similar production rate is now planned for the "Comet" aircraft, originally the de Havilland Company was faced with a dilemma on the production policy it should adopt. An excellent paper was presented by the assistant chief designer of the company, and largely reproduced in THE ENGINEER,* December 5th, page 677, in which were explained not only many of the factors which determined the power, size and shape of the prototype "Comet," but the reasons why the early production of two further marks became desirable. For in order to get this advanced project established at the earliest possible moment its basic design, when settled in 1946, was committed to a centrifugal jet turbine because of fundamental uncertainties which then prevailed with the axial-flow engine. The author pointed out that "timing is a vital factor in producing a new aircraft, and it is often better to produce a slightly inferior aircraft at the right time than a perfect one at the wrong time." The company as a private venture consequently established a production line to manufacture fifty "Comets" to this original design in order to "break even" on the investment. At that time it had orders for only sixteen machines, all for British airlines. Although each "Comet" is valued at about £500,000 the company took the risk of selling another thirty.

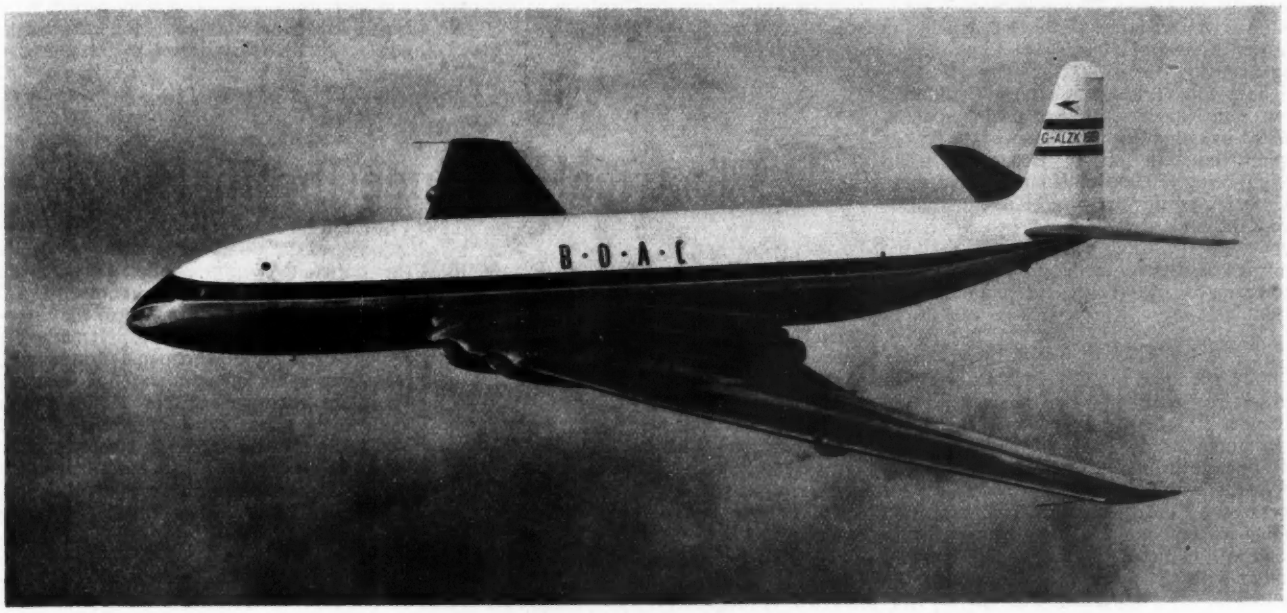
As this machine developed so did the axial-flow engine of much greater thrust and significantly better fuel consumption than the "Ghost" engines. Thus, the "Comet II" series was announced, fitted with a civilian version of the "Avon" engine and enjoying a much longer range and an increased payload with a passenger capacity of forty-four. The development aircraft of this series first flew in February last year and deliveries are expected to start towards the end of this year. The demand for this version was considerable as it could operate economically on most of the world's longest routes non-stop, at around twice the speed of existing craft. The task facing the company was how to meet these demands without prematurely abandoning the production of the necessary number of the early series. There was also the consideration that operators who would normally have purchased the early version now preferred to await for the Mk. II series, and the much larger 58–78 passenger series III scheduled for flight testing in 1954 and delivery in 1956. This version will have an all-up weight of 145,000 lb and will have four civil versions of the "Avon" engine, each developing 9000 lb static thrust. The practical stage length of this series is stated to be 60 per cent greater than the series I. The first American orders for British airliners since the early 1920s have already been received for the "Comet" series II and III machines. It was stated by the company in October last that it intended now only to produce twenty-one of the series I and I*a* machines.

The first batch of nine aircraft for B.O.A.C. were delivered by September last, fifteen months ahead of schedule, and are now flying some 80,000 miles a week on services linking London with Johannesburg, Colombo and Singapore.

There can be no doubt that very great orders for "Comet" series aircraft will be forthcoming and to meet the demand the company has arranged for three separate production lines at Hatfield, Belfast and Chester. The production line at Belfast is being undertaken by Short Brothers and Harland, Ltd., and its first machine is expected to fly in a few months' time. It is explained that this method of dispersing the production effort is not only a flexible one, in that fluctuation in demand can more easily be met by expansion or contraction of such separate units, but because it also eases the labour and housing situation. Apart from this dispersion of the production both the "Viscount" and the "Comet" are heavily subcontracted.

The latest British airliner having propeller gas-turbine engines and scheduled for quantity production is the "Britannia," made by the Bristol Aeroplane Company, Ltd., with four of this company's "Proteus" engines. It is the largest civil production aircraft this country has ever made and has an all-up weight of 140,000 lb. A fuel consumption of 0·48 lb e.s.h.p. per hour has been obtained with this engine at the cruising altitude of 35,000ft, and a mean cruising speed of 360 m.p.h. Over the shorter routes it is able to accommodate 100 passengers, and with fifty passengers or a payload of 12,000 lb it has a maximum still-air range of 5600 miles, sufficient on 80 per cent of the occasions to operate non-stop between London and New York. The delivery programme of this aircraft has benefited considerably by the extensive use of an almost complete mock-up aircraft on which much control and ancillary system testing was simulated before the first prototype flew. A first order of twenty-five machines has been placed for this machine by British Overseas Airways Corporation.

Another outstanding British aircraft fitted with propeller turbines which first flew during the year is the "Princess" flying-boat made by Saunders-Roe, Ltd. It has an all-up weight of 330,000 lb, the wing has a span of 219ft 6in and an area of 5020 square feet, and the aircraft is 148ft long. Ten Bristol "Proteus" Mk. II engines are fitted. This mark of the "Proteus" is a derated version of the Mk. III engine, which is the production version. It was announced by the Government during the year that work on the other two partly constructed "Princess" aircraft had been postponed until such time as the Mk. III engines become available. A general description of this aircraft with details of the principal features of the design were given



The "Comet"

* "The 'Comet,'" C. T. Wilkins, F.R.Ae.S., the Royal Institution of Great Britain, November 21, 1952.

in an article† by Mr. J. Brennan, deputy chief designer of Saunders-Roe, Ltd. The article contained the following paragraph :—"Structurally, the 'Princess' is of conventional design, but her size has permitted a simplicity of detail that has yielded a low percentage structural weight which compares very favourably with other aircraft. This figure is 24·8 per cent and, when it is remembered that this includes all the landing gear of the aircraft such as the retractable wing-tip floats and strengthening of the hull bottom, it will be seen that it is slightly lower than contemporary landplanes."

During the period of the S.B.A.C. exhibition, the Ministry of Supply ordered a Mk. II version of the Blackburn and General Universal freighter. This machine also ranks with the world's larger craft and is capable on shorter distances (250 miles) of accommodating a payload of 49,300 lb. The Mk. II is to have four Bristol "Centaurus" double-row, radial engines. It has a wing span of 162ft, its wing loading being 44·6 lb per square foot. In spite of its size, the all-up weight being 130,000 lb, its landing and take-off characteristics are almost reminiscent of pre-war standards. A model of this version for civilian use embodied lifts for the stowage of six cars in the hull, with accommodation for forty-two passengers in the tail boom.

Operational Statistics

It is the aim of B.O.A.C. to establish jet services encircling the world with the "Comet" series aircraft and with the "Britannia." With the "Comet" craft it will operate primarily first-class, high-speed services, with a slower tourist service operated by the "Britannia." Of the two global routes one will be westward from London and across Canada to link up at Tokyo with the existing route back to the United Kingdom, and the other will be westwards across the United States to meet the British Commonwealth Pacific Airline service to New Zealand and Australia, and so back to London along the present Kangaroo route.

The annual report and accounts for the year ended March 31, 1952, of the British Overseas Airways Corporation noted that for the first time a profit amounting to £1,233,722 was made by the Corporation, of which £274,999 was net surplus. Other items showed that the total revenue increased to £33,567,862 from £24,252,115, of which passenger revenue amounted to £19,680,109. The operating cost in pence per capacity ton-mile had been reduced from 39·5 to 38·8, and a vital economic factor also was the increase in the load factor achieved, which was raised from 59·5 per cent to 65·7 per cent on a capacity which had itself been increased by 20 per cent. The Corporation carried over 250,000 passengers, 6031 tons of freight and 2895 tons of mail.

The drastic programme of reorganisation affecting personnel, bases and aircraft, which had been in hand for the last four years, was also reviewed in the report. It was recorded that, of a total fleet of 137 aircraft in 1948, only six were basically designed and suited for the long-range character of the Corporation's business. It was forced to employ as many as nine types of aircraft and was using no fewer than eight maintenance bases. The average block-to-block speed with these improvised machines was only 186 m.p.h., their average payload capacity was only 3 tons, and average seating capacity was nineteen. Now the Corporation has only five types of aircraft in service, the report continues, and is using only two major maintenance bases ; its aircraft operate with an average block-to-block speed of 225 m.p.h., the average carrying capacity has been doubled, to 6·21 tons, as has the seating capacity to forty-one. It is shown in the report that in 1947-48 the combined staffs of B.O.A.C. and the former B.S.A.A.C. averaged 24,101 persons, and the total revenue worked out at only £607 a head. By March, 1951, the staff of the Corporation had been reduced by 33·3 per cent and the revenue earned per head by March, 1952, had risen to £2047. During this period the operating costs in pence per capacity ton-mile had been reduced from 56·6 to 38·8. In presenting his report, Sir Miles Thomas, D.F.C., chairman of the Corporation, also had this to say about its commercial outlook : "... the fourth phase in reconstruction was the imprinting on the minds of staff at all levels the idea that the Corporation was essentially a commercial undertaking ; that the financial aspect of every single activity mattered, and that the ultimate test of the Corporation's success was not only the standard of public service it provided, but also the normal business criterion of whether it could be made to pay its way."

At the end of the financial year in review the fleet of the Corporation comprised twenty-two "Argonauts," ten "Stratocruisers," ten "Constellations," twenty "Hermes," and ten "Yorks" on freight service. All orders now outstanding are for British aircraft — the de Havilland "Comet" and the Bristol "Britannia." The safety record of the Corporation was maintained during the year and over 2000 million passenger-miles have been operated during the last four years without fatality or serious injury to passengers.

† "The Saunders-Roe 'Princess' Flying-Boat," *Aircraft Engineering*, October, 1952.

(To be continued)

Electrical Engineering in 1952

No. I

A NEW factor made itself felt in the British electricity supply industry in 1952, when, for the first time since the war, there was a marked decline in the hitherto steady rate of increase in electricity consumption. In November, 1951, for example, the annual growth over the country as a whole was 9·8 per cent, but by last November this figure had fallen to only 2·6 per cent. This trend reflects to some extent the industrial recession that has afflicted some parts of the country and it would give grounds for concern if it were to persist.

In a negative sense, of course, the slackening of demand had the effect of easing, at least temporarily, the strain on generating plant capacity. A more positive contribution towards the same end was made by the installation of 1232·5MW of generating plant and 14,115k-lb per hour of boiler plant (at the time of going to press). The two effects combined to reduce the plant deficit by a significant amount, but it is clear that the gap between supply and demand will continue to govern the operations of the supply industry this winter.

Since the installed generating and transmission capacity is still inadequate to meet the potential demand, it is appropriate that this review should begin with a short summary of what was done in 1952 to make good the deficiency. The main items of plant commissioned by the B.E.A. are given in the accompanying table, which shows the position at the time of going to press.

This table includes four new generating stations—Keadby, Brunswick Wharf, Huncoat and Barking "C"—which came into operation during the year.

Keadby is one of three stations under construction by the Yorkshire Division. It lies north of the Stainforth and Keadby canal and about half-a-mile west of the River Trent, about 9 miles from its confluence with the River Ouse. Ultimately the station will have a capacity of 360MW, made up of six 60MW Parsons turbo-alternators and six 550,000 lb per hour Stirling boilers, the turbine stop valve steam conditions being 900 lb per square inch and 900 deg. Fah. Each turbine is associated with its own boiler as an independent unit, without any cross connections. The boilers are pulverised fuel-fired, single-drum installations with continuous loop superheaters and interpass attemperators for control of the outlet temperature and a system of fully automatic combustion control is included in the equipment. One of the turbo-alternators is shown opposite. It embodies a three-cylinder, 3000 r.p.m. turbine with forty-four rows of pure reaction blading. There are five stages of feed heating with a final water temperature of 386 deg. Fah. The turbine is direct coupled to the alternator and geared to the main and pilot exciters. Circulating water for the condensers is taken by three 72in diameter mild steel inlet pipes from the River Trent, with three similar outlet pipes discharging into the river, half-a-mile downstream.

New Generating Plant Commissioned by B.E.A. in 1952

Power station	Generating division	Sets, MW.I.	Boilers, k-lb/hr.
Bankside	London	—	2×375
Barking C	London	1×75	—
Battersea	London	—	2×425
Blackburn	North Western	—	2×150
Blackwall Point	London	1×30	1×365
Braehead	S.W. Scotland	1×50	2×300
Brighton	—	1×52·5	2×320
Bromborough	Merseyside	2×50	2×300
Brunswick Wharf	London	2×52·5	4×320
Clarence Dock	Merseyside	—	2×350
Cliff Quay	Eastern	1×45	—
Croydon	South Eastern	—	2×320
Deptford East	London	—	1×250
Huncoat	North Western	1×30	2×305
Keadby	Yorkshire	2×60	—
Littlebrook C	—	1×60	2×360
Nechells B	Midlands	1×52·5	3×230
Northampton	E. Midlands	1×30	2×175
North Tees	North Eastern	2×60	2×360
Plymouth B	South Western	2×31·5	2×320
Poole	Southern	1×50	2×300
Portsmouth	Southern	1×30	2×180
Rotherham	Yorkshire	—	1×200
Rye House	Eastern	1×32	1×350
Skelton Grange	Yorkshire	1×60	2×360
Staythorpe	E. Midlands	1×60	2×240
Thornhill	—	1×45	—
Uskmouth	—	1×60	2×360
Warrington	Merseyside	1×30	1×200
West Ham B	London	2×30	3×180
Westwood	North Western	1×30	2×300
Woolwich	—	1×30	2×180

All coal supplies for Keadby power station are rail-borne from the Doncaster-Scunthorpe line, which runs to the south of the site, with a connection to extensive sidings west of the station buildings.

Huncoat power station (illustrated opposite), near Accrington, is one of seven stations now under construction in the North Western Division. The ultimate output of the station will be 120MW and the plant now being installed comprises three Simon-Carves boilers and two 30MW G.E.C. turbo-alternators.

Each boiler is pulverised fuel-fired and has an output of 305,000 lb per hour, at 600 lb per square inch and 850 deg. Fah. The boilers

are provided with automatic control with grid controlled rectifiers supplying direct current for the i.d. and f.d. fan motors and other auxiliaries. The turbines are two-cylinder, impulse-reaction, 3000 r.p.m. units, with double-flow l.p. cylinders, with one l.p. and three h.p. bled steam feed-heating stages. The generated voltage is 11kV, which is stepped up to 33kV by generator transformers which are installed outdoors in front of the main turbine building.

The condenser cooling water is circulated through the 300ft high concrete cooling tower, which deals with 3,000,000 gallons per hour. There will ultimately be two cooling towers. Make-up water for the boilers and the cooling tower is drawn from the Leeds and Liverpool canal, which runs past the site, and the canal level is maintained by water pumped from various sources at distances up to 6 miles from the station. Coal is brought by British Railways to new sidings from which a Simon-Carves conveyor system, bridging the main railway line, feeds the station bunkers or storage ground.

The control buildings, which form a separate block, will house the main control room, relay room, tele-communications room and station battery.

The consultants are Messrs. Kennedy and Donkin and L. G. Mouchel and Partners, Ltd.

Brunswick Wharf power station occupies a site of about 19 acres on the north bank of the River Thames at Blackwall and has a deep water frontage to the river of 850ft. An ultimate generating capacity of 330MW is envisaged, consisting of four 52·5MW and two 60MW Metropolitan-Vickers turbo-alternators. Each of the 52·5MW machines consists of a three-cylinder turbine designed for initial conditions of 900 lb per square inch and 900 deg. Fah., and is direct coupled to a 61,765kVA, totally enclosed, separately fan-cooled, direct-excited alternator. There are five stages of feed-heating, the final condensate temperature at M.C.R. being 365 deg. Fah. Both the 60MW sets comprise a three-cylinder turbine designed for initial conditions of 900 lb per square inch and 900 deg. Fah., direct coupled to a 75MVA totally-enclosed, hydrogen-cooled, direct-excited alternator.

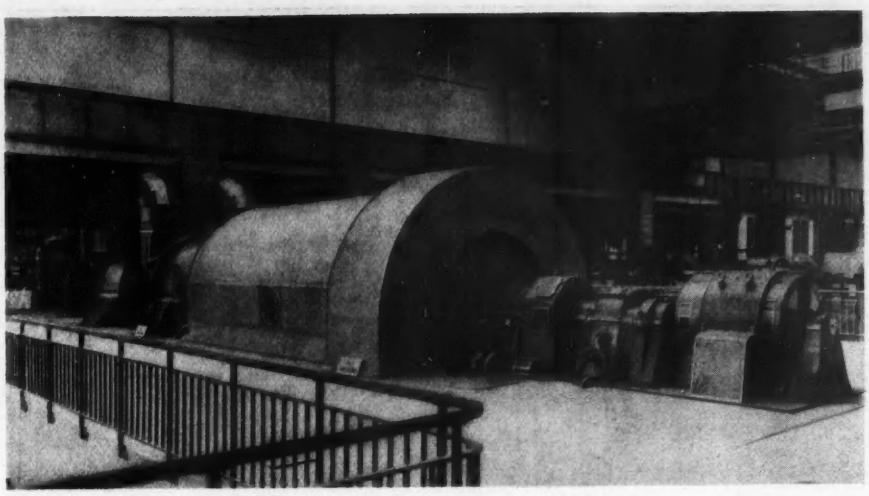
Ultimately the steam generating plant will consist of twelve pulverised fuel-fired boiler units; at present ten Clarke Chapman boiler units are being installed, each having an output of 320,000 lb per hour at terminal conditions of 925 lb per square inch and 925 deg. Fah., with fully automatic control. Each boiler unit is provided with Howden "Centicell" dust extraction equipment, followed in series by a Sturtevant electrostatic precipitator unit.

The coal handling plant is designed for a jetty crane installation of four Stothert and Pitt high-speed level luffing cranes, each with a capacity of 200 tons of coal per hour. Three of these cranes are at present being installed. They will discharge sea-borne coal to a conveyor belt system designed to handle 800 tons per hour.

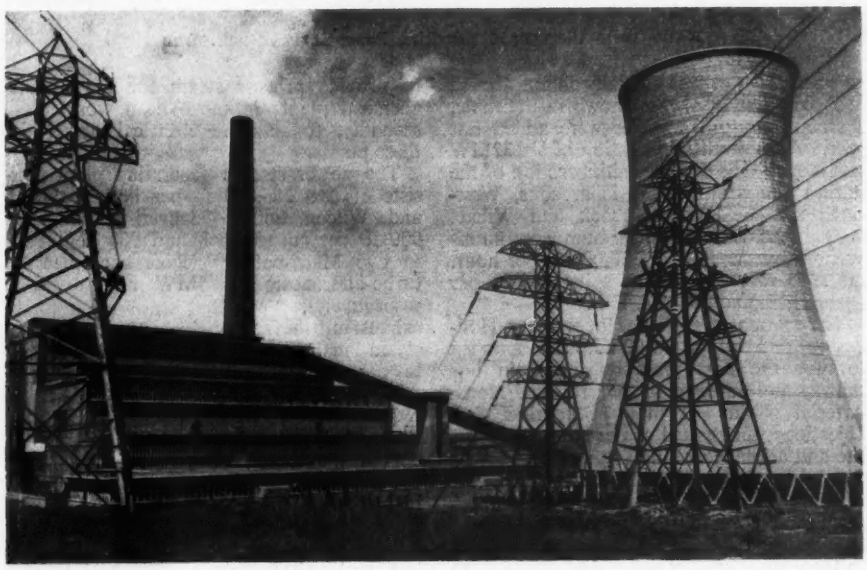
Generation is at 11·8kV stepped up by unit transformers to 132kV for transmission. The 132kV switchgear is B.T.H. air-blast equipment and is housed in a switch house separate from the main station buildings.

The main consulting engineers are John Bruce and Partners, in association with Mouchel and Partners for the civil engineering works.

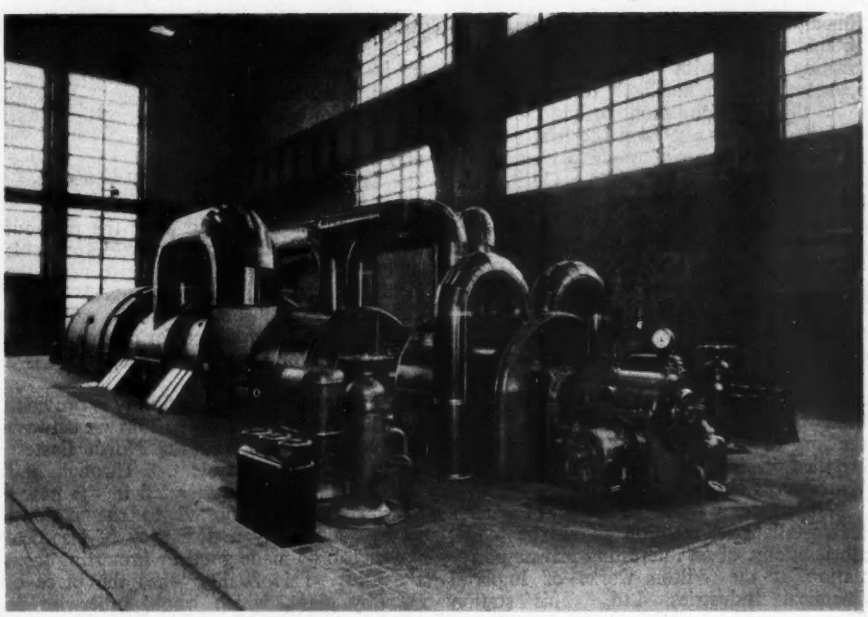
In the accompanying Art Plate 5 we illustrate the exterior of Rye House power station, in which the first of six 32MW



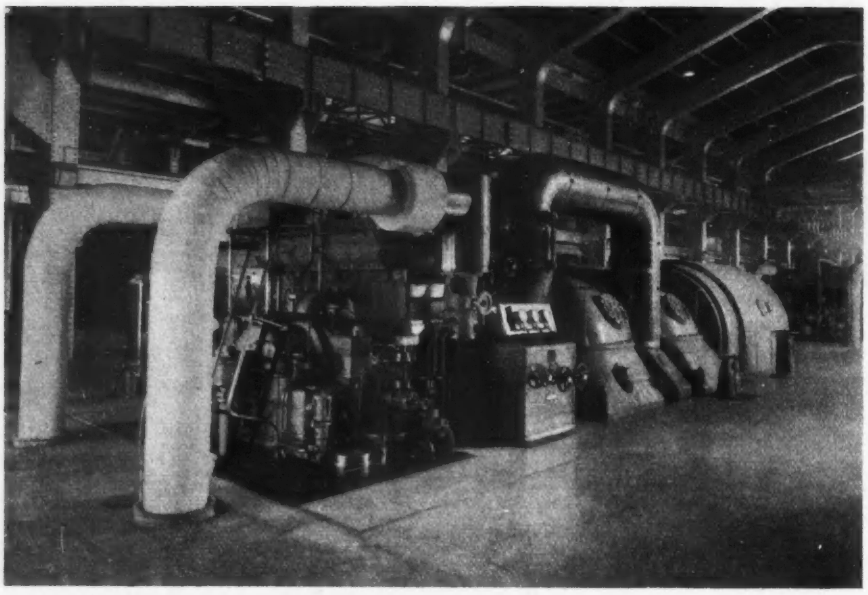
60MW Set at Keadby Power Station



Huncoat Power Station



50MW Turbo-Alternator at Braehead



20MW Turbo-Alternator at Hex River Power Station, South Africa

turbo-alternators was officially commissioned in December, 1951. As shown in the table, a second set and a boiler were added last year. An ultimate installation of six 32MW sets is envisaged and the initial section of the station consists of two Richardsons, Westgarth sets, and two Babcock and Wilcox boilers each with a maximum continuous evaporative capacity of 350,000 lb per hour. the stop valve conditions being 650 lb per square inch and 850 deg. Fah.

The station is at Rye House, near Hoddeston, and occupies a 90 acre site bounded towards the north-west by the main line railway and adjacent to the proposed North Arterial Road. It may be recalled that objections were raised against the use of the site and a joint local inquiry was held by the then Electricity Commissioners and the Ministry of Town and Country Planning. Eventually consent was given to the use of the site, subject to certain safeguards relating to the preservation of amenities.

A limited amount of electricity is expected to be available from the new Bankside power station in the periods of heavy demand during the present winter. Because of difficulties which have been experienced in obtaining cast iron casings, the flue gas washing plant with which the station is being equipped is not likely to be ready for some three or four months, but the initial 60MW generating set and the first two oil-fired boilers will begin commercial operation within the next few weeks. During the winter months the normal stages of trial and adjustment of new plant should be completed, so that the station may begin to run normally with the gas-washing plant as soon as it is ready.

Two of the accompanying illustrations show what may be regarded as typical examples of British generating sets installed during the year. On page 27 we illustrate a 50MW Parsons turbo-alternator at Braehead power station; above we show the first of three 20MW B.T.H. sets to be installed in the Hex River power station, Worcester, South Africa.

Before turning from the subject of generator installations, mention should be made, albeit briefly, of an interesting private power station at the Wilton works of Imperial Chemical Industries, Ltd. This station (Plate 5, opposite), which was described in our issue of December 19th, is designed primarily to provide process steam for the various chemical plants in the Wilton works and, secondly, to generate electrical power for these plants.

The power station generating plant consists of two 265,000 lb per hour Babcock and Wilcox boilers, delivering steam at 900 lb per square inch and 900 deg. Fah. to two Metropolitan-Vickers back-pressure turbo-alternators (17·5MW and 8·3MW, respectively), which exhaust into the factory steam mains at 250 lb per square inch. After the factory steam requirements have been met the remainder of the steam, at 250 lb per square inch, is let down through either of two Metropolitan-Vickers pass-out turbo-alternators of 23·5MW and 11·35 MW capacity, respectively. Most of the steam is passed out into the factory mains at 20lb per square inch or is used for feed-water heating. For flexibility of operation at times when the process steam demand is less than the electrical load, additional turbine stages are added after the pass-out connections, leading to condensers capable of handling up to about 25 per cent of the steam supplied to the sets.

Normally the boilers burn pulverised fuel but they are designed for oil-firing when required or for burning tail gas, which is a waste gas from the works.

On the electrical side flexibility is provided by a link, with a capacity of 30MVA between the power station and the North Eastern Electricity Board system. Through this link surplus energy generated in the power station can be exported to the national grid; conversely a deficiency of electrical power can be made good by importing from the grid. This facility takes the place of standby plant, which would otherwise be required in the power station.

(To be continued)

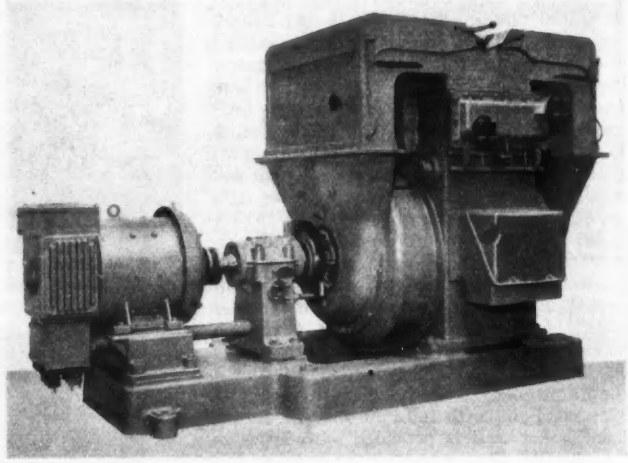
A Self-Contained Alternator and Air Cooler

OUR illustration below shows a turbo-alternator incorporating special cooling arrangements to ensure reliability under unusually difficult site conditions. The alternator was built by the General Electric Company, Ltd., for Sena Sugar Estates, Ltd., and is rated at 700kW at 1800 r.p.m., to provide a 400V, three-phase, 60 c/s supply for a sugar factory at Luabo, in Portuguese East Africa.

Three main factors had to be considered in the design of the alternator cooling system; first, the high ambient temperature at Luabo, which averages 90 deg. Fah. for the first few months of the sugar crop, rising to 100 deg. Fah. during the latter part of September, with peaks of 110/114 deg. Fah. at mid-day; secondly, the presence inside the factory of considerable quantities of bagasse dust from the crushed sugar cane, and, thirdly, the risk of flooding precluded the adoption of a conventional design with coolers mounted in the foundation of the alternators.

As shown in the illustration, the machine produced to meet these requirements embodies closed-circuit ventilation, with an air cooler mounted above the alternator. The exciter is a totally-enclosed, fan-cooled machine, direct-coupled to the alternator and mounted on a common bed-plate. Normally air is drawn through the cooler into the alternator by fans mounted on each side of the rotor and is exhausted into vertical ducts which are connected to the inlet side of the cooler. The air then passes over the water tubes of the cooler and is recirculated through the machine.

Under extreme conditions of temperature, when closed-circuit cooling is inadequate, spring-loaded dampers in the air ducts are released by means of an emergency trip lever mounted above the cooler. Air is then drawn into the system through two apertures in the top faces of the ducts and passes through the cooler before entering the alternator, from which it is exhausted to atmosphere through vents in the sides of the ducts. To return to normal running conditions with closed-circuit cooling, the dampers are closed by hand.

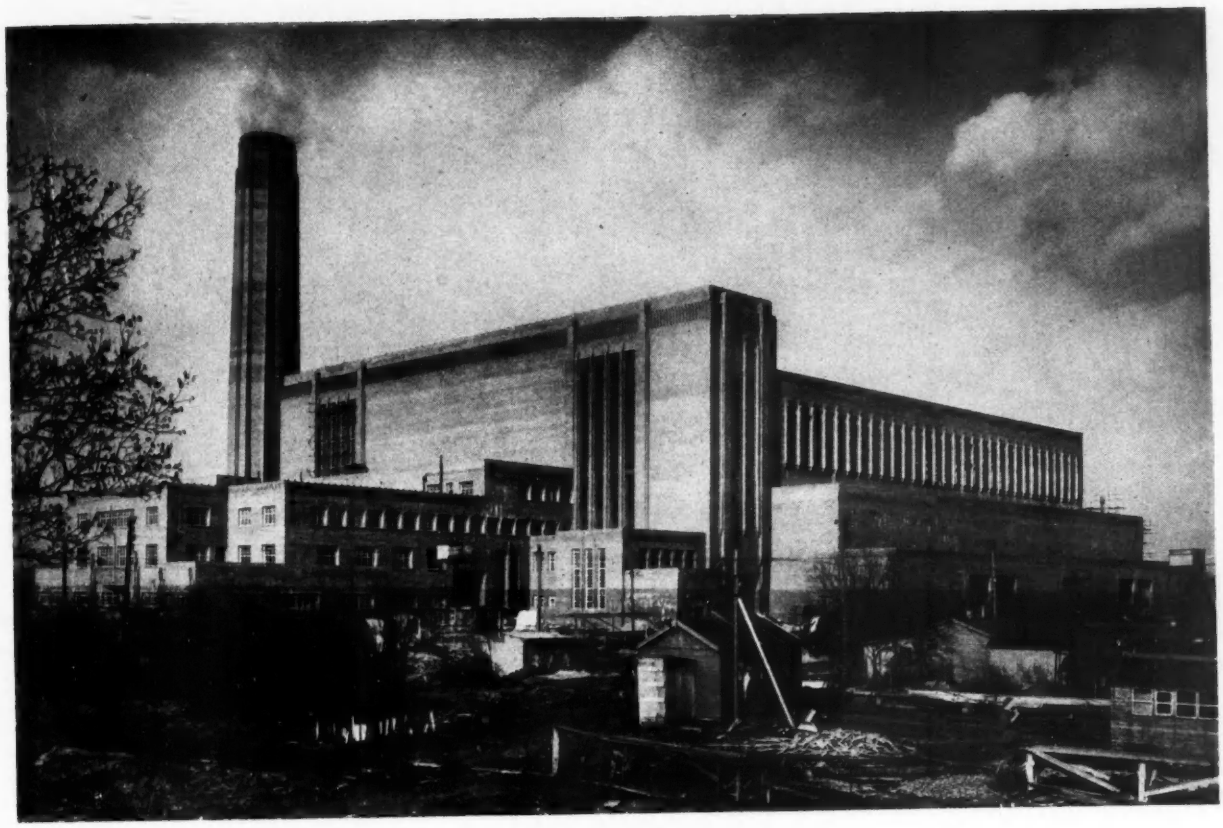


Alternator, Exciter and Air Cooler Unit for Portuguese East Africa

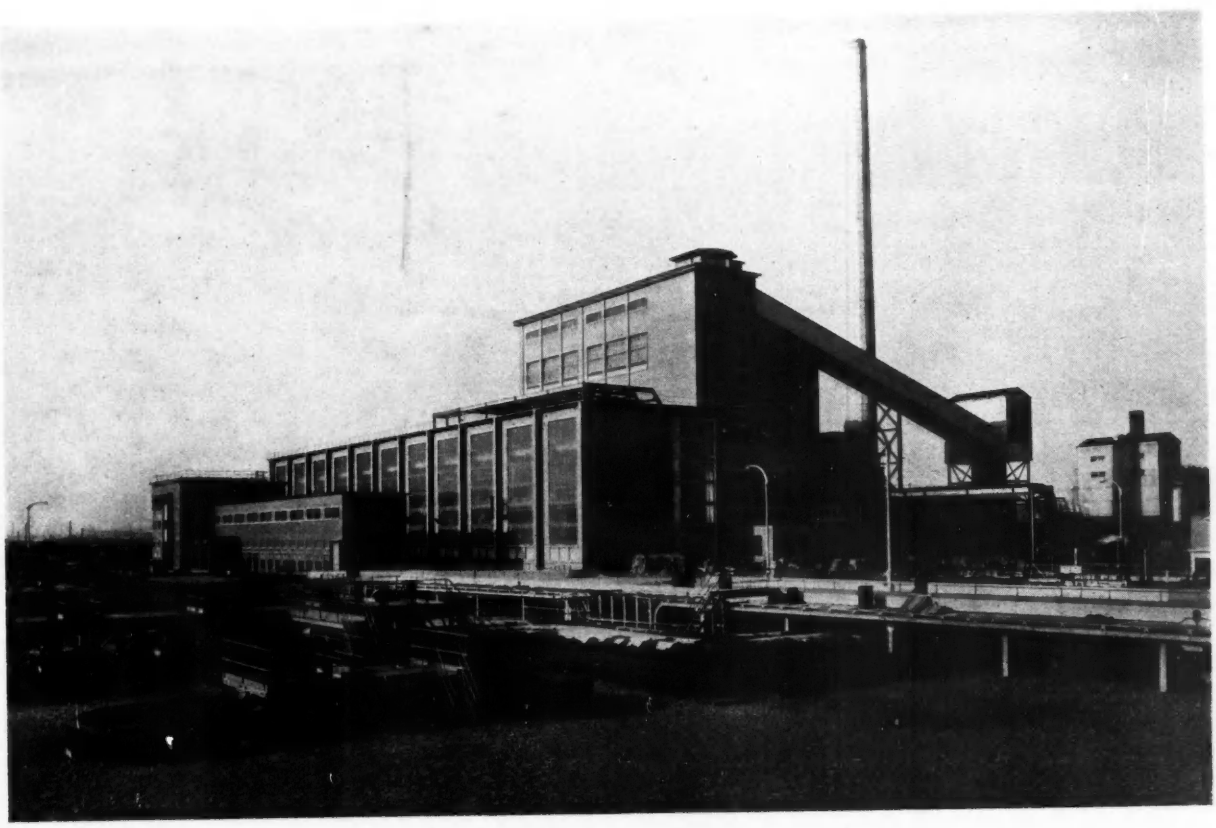
---

LECTURES ON "THE HUMAN FACTOR."—The Department of Industrial Administration of the Birmingham College of Technology has announced a lecture discussion course for directors and senior management on "Recent Researches into the Human Factor." The lectures will be given on five consecutive Thursday afternoons at 4 p.m., beginning on February 12th. The first lecture will be by Sir Charles Renold, who will deal with "The Aim of Joint Consultation." Subsequent lectures are by Mrs. Winifred Raphael on "The N. I. I. P. Survey"; Dr. W. H. Scott on "Three Merseyside Studies"; Dr. Elliott Jacques on "The Changing Culture of a Factory," and Mr. J. M. Fraser on "The Findings and Their Implications." Application to attend the course—for which the composite fee is two guineas—should be made to the Registrar, College of Technology, Suffolk Street, Birmingham, 1, by January 29th.

GENERATING STATIONS, 1952

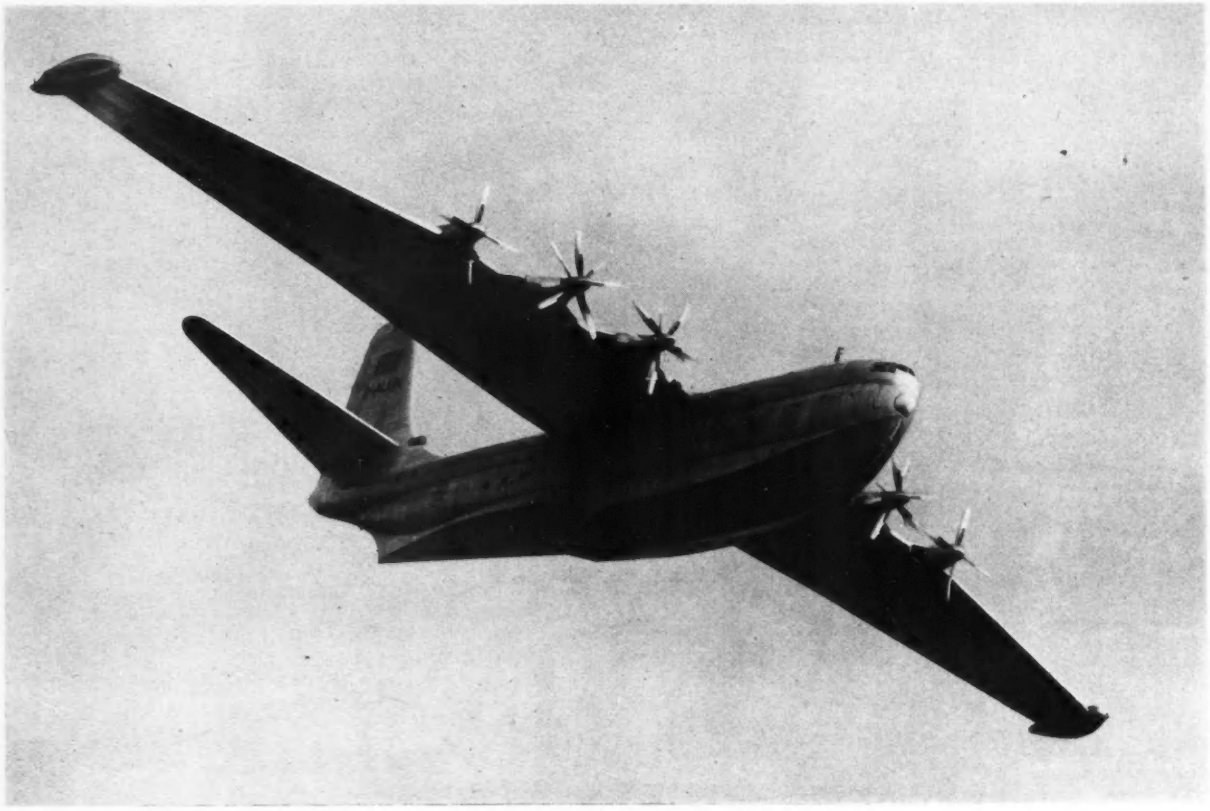


Rye House Generating Station, B.E.A.

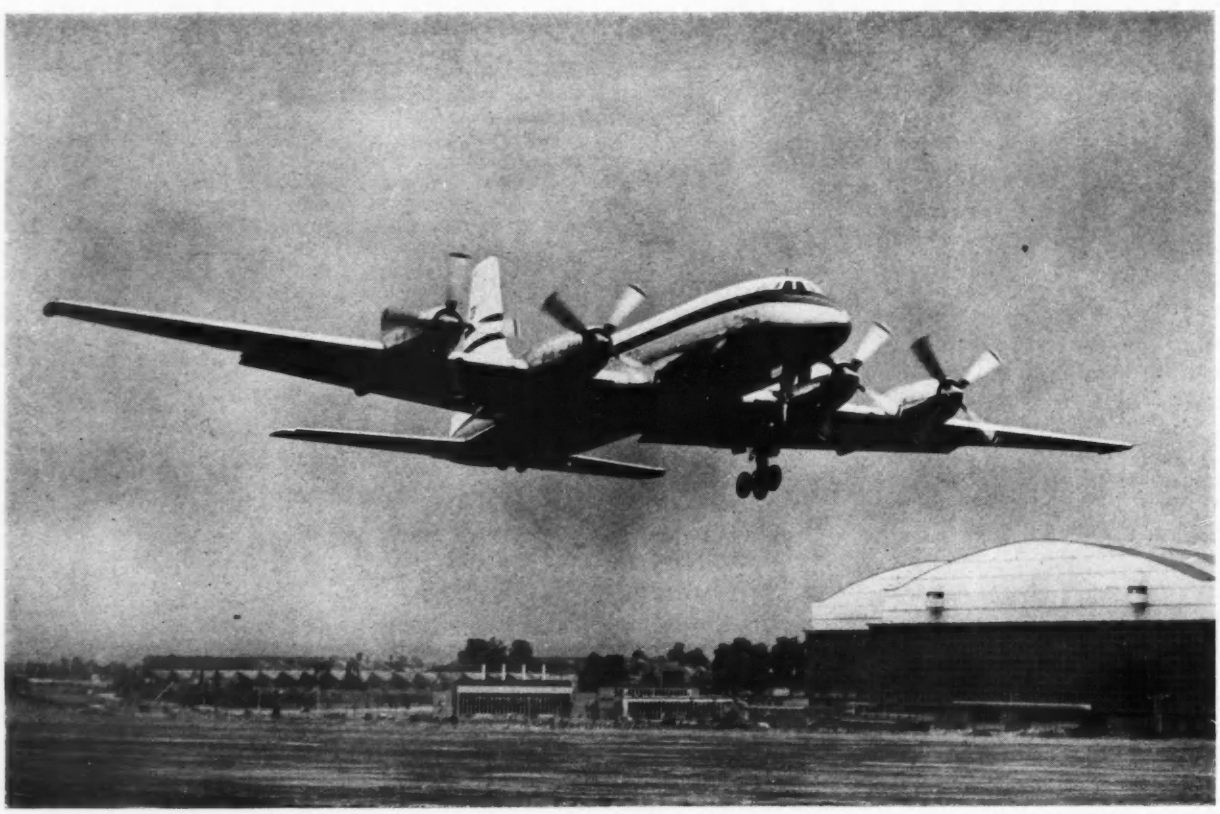


Wilton Works Power Station

GAS TURBINE TRANSPORT AIRCRAFT IN 1952



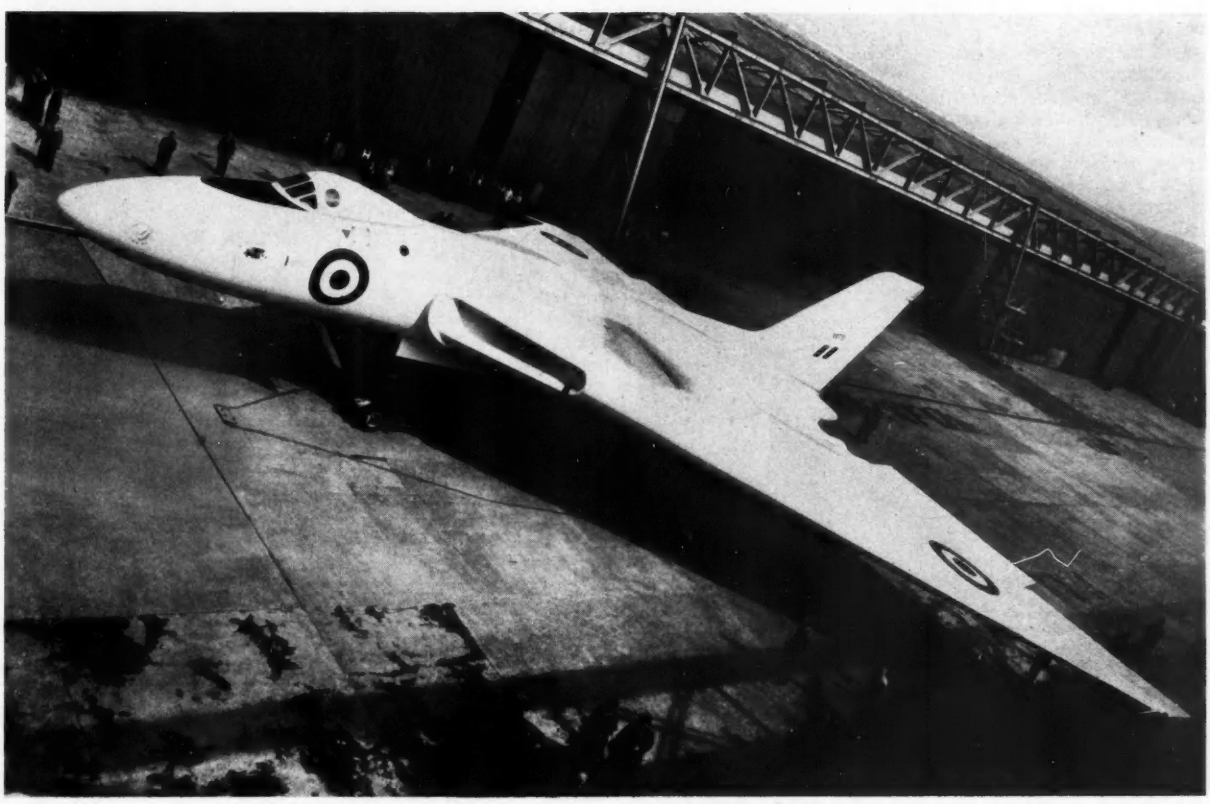
The Saunders Roe "Princess"



The Bristol "Britannia"

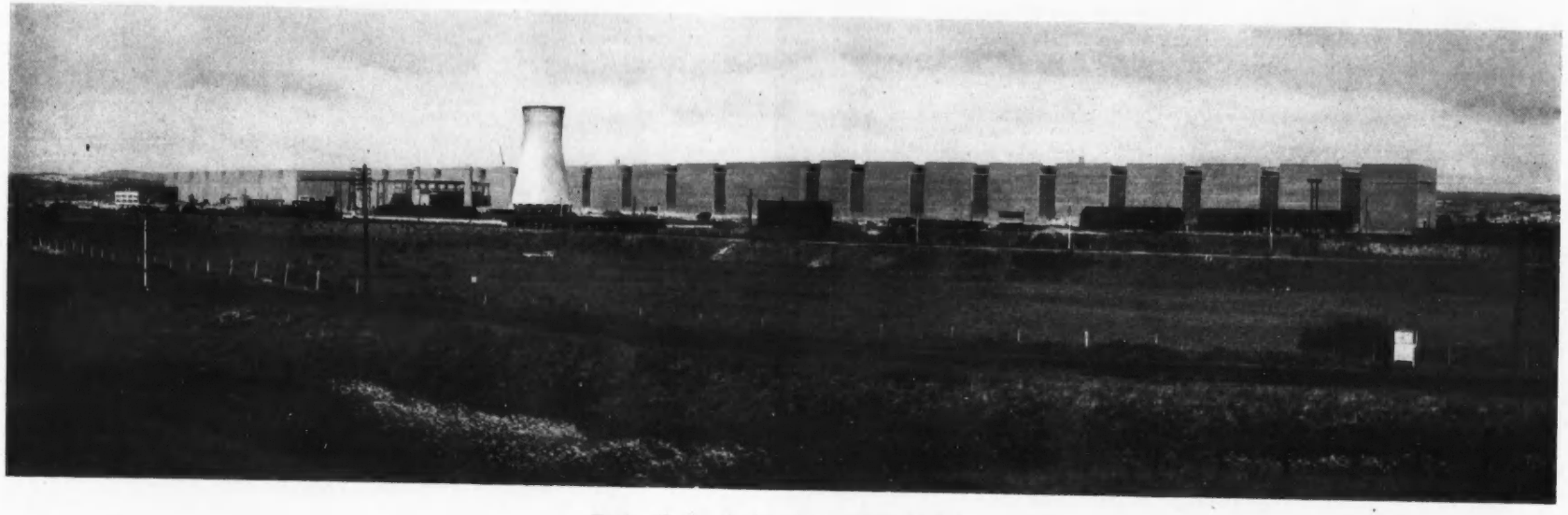
PRODUCTION DELTA WING AIRCRAFT OF 1952

The Gloster "Javelin"



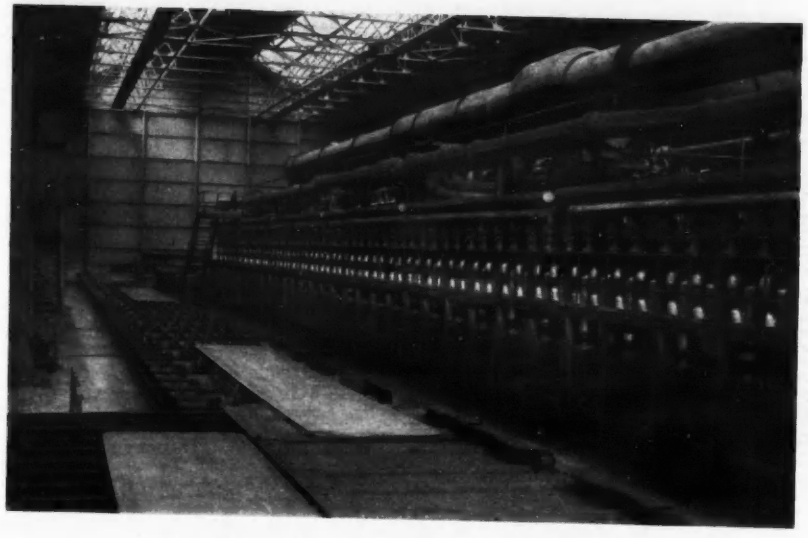
The Avro "Vulcan"

STEEL WORKS OF 1952



Trostre Tinplate Works—Steel Company of Wales

Raw Materials Preparation Plant—Appleby-Frodingham Steel Works



Normalising Furnace—Appleby-Frodingham Steel Works

The British Iron and Steel Industry in 1952

No. I

THE British iron and steel industry has now been under public ownership for nearly two years. As last year ended, however, progress was being made in Parliament with the various stages of the Iron and Steel Bill, designed to repeal the Iron and Steel Act, 1949, and thus return the industry to private ownership, making provision at the same time for an appropriate measure of public supervision. The intention to introduce that legislation, it will be recalled, was indicated in the King's Speech at the opening of the present Parliament in November, 1951. Subsequently, it was announced that to cover the period which must necessarily elapse before the Bill embodying these proposals could be introduced, the Government had decided to issue a statutory direction to the Iron and Steel Corporation. By that direction the Corporation would not be able to take, without the written consent of the Minister of Supply, action which would result in "any alteration in the financial structure or management of any publicly owned company or of any other company under the control of the Corporation, or the sale or disposal of any part of the undertaking or securities held by any such company."

Ownership and Supervision of the Industry

Throughout last year, therefore, the iron and steel industry was able to feel with growing assurance that the complexities brought about by nationalisation were diminishing, and that, despite any political opposition that might be offered, its return to private enterprise was not far distant. As it was not found possible to introduce the Iron and Steel Bill before Parliament was prorogued in the autumn, the Government published its main proposals in the form of a White Paper in July. Prior to their publication, the proposals had been discussed with the Iron and Steel Corporation, the Iron and Steel Consumers' Council, the British Iron and Steel Federation, the Trades Union Congress and other bodies. So far as the public supervision of the industry is concerned, following its return to private ownership, the intention is to set up an Iron and Steel Board, consisting of an independent chairman and not more than eleven other members, with experience in the iron and steel industry, in the engineering and other industries using iron and steel, and in trade unions. The Board's responsibility will be "to exercise a general supervision over the iron and steel industry, with a view to promoting the efficient, economic and adequate supply under competitive conditions of iron and steel products." In particular, it is to keep under review the industry's productive capacity, arrangements for procuring and distributing raw materials and fuel; home prices; arrangements for research, training and education; arrangements for the promotion of the safety, health and welfare of employees, and arrangements for joint consultation on matters of mutual interest other than terms and conditions of employment. The proposal for the setting up of this Board has been embodied in the Iron and Steel Bill which was given its second reading in the House of Commons in November, and which will soon be passing through the Committee stage. The Bill also provides for the appointment of an "Iron and Steel Holding and Realisation Agency" to effect the return to private ownership of the publicly owned companies whose securities will be transferred to it, on an appointed day, from the Iron and Steel Corporation of Great Britain. One month—or such longer period as the Minister of Supply may determine—after the "appointed day" the Iron and Steel Corporation will cease to exist.

The Iron and Steel Productivity Report

An event of no little importance was the publication, at the end of June, of the report of the iron and steel productivity team which visited the U.S.A. in 1951, under the ægis of the Anglo-American Council on Productivity. The team, which was led by Sir Charles Goodeve, visited eight American steel plants, and in formulating its report kept fully in mind the facts that the American steel industry is about six times as great as the British, and that better quality raw materials and fuel are available to it. Taking all the factors into consideration, it could not be deduced from the report that the technical efficiency of the American steel industry is higher than that which has been reached in this country. But some of the conclusions arrived at by the productivity team, and the recommendations made as a result, have already been carefully noted for the future development of the British iron and steel industry. The report urged, for example, that blast-furnaces with a minimum hearth diameter of 25ft for imported ore and 27ft for home ore should be accepted as a normal standard in all new developments. Another recommendation was that all integrated steel works should aim at a standard output of 750,000 to 1,000,000 ingot tons annually, the view being expressed that, despite existing limitations, several improvements in the layout details of British works were possible. Those recommendations were especially helpful, as when they were made the industry was engaged upon the preparatory work associated with its second development plan, a matter to which reference is made later in this review.

Output and Supplies

At the time of going to press with this issue, the final figures of last year's iron and steel production have not been announced. The estimate which has been made by the British Iron and Steel Federation is 16,050,000 tons of steel ingots and castings and 10,575,000 tons of pig iron. The production totals for the first eleven months of last year, up to the end of November, were 14,849,000 tons of steel and 9,696,000 tons of pig iron—with approximately five weeks to go to the end of the year. In 1951, it will be recalled, steel production amounted to 15,638,000 tons and was about 2 per cent below the estimate made at the beginning of that year, and pig iron production, at 9,669,000 tons, was also slightly below the estimate. This latter result was attributable to a limit on coke supplies in the closing months of 1951. But the 1951 steel output was not achieved without considerable running down of the stocks of pig iron and scrap, and, at the beginning of last year there was naturally some caution on the part of the industry in attempting to assess the prospects for 1952 as a whole. It was pointed out by the British Iron and Steel Federation that, if steel production was to reach 16,000,000 tons, pig iron output must be increased by at least 1,000,000 tons, of which 570,000 tons would be required to make good the amount of stocks drawn upon in 1951, and the balance to bring steel output up to 16,000,000 tons. Even then, no provision would be made for increasing the raw material stocks above the low level at which they stood at the beginning of last year. At the same time, it was realised that 1,000,000 tons more pig iron in 1952 was well within the capacity of the additional blast-furnaces which were becoming available, provided the supplies of essential raw materials could be increased.

By the end of March steel output was at an annual rate of 16,648,000 tons, although the annual rate over the whole of the first quarter was 500,000 tons below the comparable figure for 1951. On the other hand, the annual rate of pig iron production during the first quarter of last year, at 10,355,000 tons, was nearly 1,000,000 tons above the corresponding figure for 1951. But coke supplies remained inadequate to meet the needs of the blast-furnaces, and in order to reach a pig iron output in March approximating to an annual rate of 10,478,000 tons, coke stocks were drawn on to the extent of 2000 tons a week. As the year progressed, however, there was steady improvement in the coke position, and with new blast-furnaces coming into operation pig iron production by the end of October was nearly 10 per cent higher than in the preceding year. In November, pig iron production was at an annual rate of 10,753,000 tons, while steel output reached an annual rate of 17,951,000 tons—the highest rate recorded in the history of the industry.

The main factor in the steady improvement in crude steel output during the year was, of course, the increased pig iron production. It offset to a large extent the decline in the supplies of imported steel-making scrap which in the post-war years has constituted an important part of the industry's raw material. In 1950, scrap was imported into this country at the rate of 163,200 tons a month, but in 1951 the average monthly import fell to as low as 49,800 tons. Over the first ten months of last year there was some improvement, the average amount of scrap received from overseas sources being 59,500 tons a month. At home, the scrap drive which was initiated early in 1951 was continued throughout last year, and before the end of the year steelmakers' receipts of scrap from home sources (other than shipbreaking) had exceeded the 1951 deliveries by over 300,000 tons. Moreover, with the improvement in pig iron supplies, the percentage of scrap used in steel-making fell, the average for last year being about 55·5 per cent compared with 60·2 per cent in 1946. Iron ore supplies also improved last year, imports over the first ten months averaging 817,700 tons a month, compared with a monthly average of 731,800 tons in 1951, and the production of home ores averaging 306,900 tons a week compared with 284,200 tons in 1951.

But supplies of finished steel last year were again not equal to the demand, although as the year ended the prospects were more favourable than in some of the earlier months. Deliveries of finished steel averaged rather more than 245,000 tons a week as against 243,000 tons in 1951, although in the first quarter of the year supplies were slightly below those in the comparable quarter a year earlier. There was a steady improvement in the home production of steel as the year proceeded, and imports were greater. In the first nine months of last year, imports of semis totalled 322,000 tons, or nearly

three times the amount imported in 1951; finished steel imports in the same period, totalling 576,000 tons, were more than three times greater, whilst imports of ingot steel were 286,000 tons, compared with none in 1951. These figures take into account, of course, the quantities received from the U.S.A. towards the fulfilment of the arrangement made last February to make available to this country 1,000,000 tons of steel during 1952.

The supply situation, however, in the face of the growing claims of rearmament and the demands of the export drive made it imperative early last year that an allocation scheme should be introduced. The scheme operated from February, the Government emphasising the necessity to allocate the available steel supplies to their most important uses. It was also stressed that, as soon as more steel became available, allocations would be increased. The rising trend of finished steel supplies has made possible some relaxations in the allocation scheme, although some important users of steel are still getting much less than they want.

Steel Development Plans

Reference has already been made to the increased pig iron production last year consequent upon more blast-furnace capacity becoming available. This, of course, was in line with the aims of the steel industry's first post-war development plan which received the Government's approval in April, 1946. From that time, the plan has provided the basis on which the steel industry's development has been carried forward, though there have been some variations as events have altered conditions and new factors have had to be taken into account. The general objective of this development plan was to modernise and increase steel capacity to 16,000,000 tons a year by 1953. Subsequently, it was determined that by the middle 1950s there should be capacity sufficient to ensure a supply of 18,000,000 tons of steel, including about 500,000 tons of imported steel. The latest estimate is that production will rise to 17,500,000 tons this year, and it can therefore be said that much of the reconstruction and extension work put in hand under the first development plan was virtually complete by the end of last year. When the plan was agreed upon early in 1946, it was estimated that the cost of the schemes mentioned in it would total £168 million, but that figure has since risen to nearly £310 million because of the increase in costs of all kinds which has had to be faced in recent years. But the excess is accounted for in part by the fact that in some of the schemes—as, for example, the Abbey Works of the Steel Company of Wales, Ltd., the extensions at Shotton put in hand by John Summers and Sons, Ltd., and the works of the Consett Iron Company, Ltd., in Durham—the increased capacity actually achieved has been much greater than was originally envisaged. The following table shows the amounts expended each year since 1946 under the development plan :—

	£
1946	5,000,000
1947	30,000,000
1948	40,200,000
1949	50,300,000
1950	56,700,000
1951	62,400,000
1952	65,000,000
Total	£309,600,000

In considering these figures, however, it should be borne in mind that the new sites and plant units established under this first development plan will enable further expansion and modernisation of the iron and steel industry to be carried out at a relatively lower actual cost per ton of additional output.

An important objective of the plan was to increase efficiency and productivity in the steel industry. A measure of the progress which has been achieved in this respect is given by the index of productivity in steel melting and rolling which is prepared by the British Iron and Steel Federation. There it is shown that output per man-year (1938=100) rose by 25 per cent from 115 in 1946 to an estimated 144 in 1952.

Before the end of last year, the main outlines of a second development plan for the iron and steel industry had been prepared and had been submitted to the Government. The objective of that plan is to raise steel production to 20,000,000 tons annually, and pig iron production to 15,000,000 tons a year.

Development Work in 1952

In Plate 8, three illustrations are given of some of the work accomplished last year under the first development plan. The vast programme of work undertaken by the Steel Company of Wales, Ltd., advanced another stage by the opening in the autumn of the Trostre tinplate works, and one of the views reproduced shows the main mill building which has a total length of 2280ft. The Trostre plant, which occupies a site of about 420 acres, was described in our issues of September 26, October 3 and 10, 1952. Eventually, the plant will receive something like 7000 tons of hot rolled coil a week from the Abbey Works for processing into 140,000 boxes of tinplate a week.

The other two photographs reproduced in Plate 8 illustrate work which is proceeding at the Appleby-Frodingham iron and steel works, of the United Steel Companies, Ltd., at Scunthorpe, Lincolnshire. One of these views shows the construction of additional raw materials preparation plant. As part of the same project, two existing blast-furnaces have been enlarged to provide hearth diameters of 25ft, and work started early last year on two additional blast-furnaces, each of 25ft hearth diameter. These latter furnaces—the estimated cost of which is £10,000,000—are expected to be completed in 1954. They will produce an additional 500,000 tons of pig iron a year.

The third view on Plate 8 shows part of a new continuous normalising plant which has been completed at the Appleby-Frodingham works. When the plate mills there began operations in 1927, the 7ft mill, a single-stand two-high unit, had a capacity of about 1200 tons weekly. Facilities for normalising were provided in the shape of a single batch furnace, with a capacity of about 300 tons per week. During the war, the capacity of the 7ft mill was doubled by the addition of a four-high stand, and the weekly output has since been increased to about 2800 tons. To maintain the same capacity for normalising expressed as a percentage of the mill's output, additions to the normalising facilities had to be considered. At the same time, it was recognised that the thinner plates tended to work harden through finishing rolling at low temperatures, and consideration was given to means of stress-relieving such plates by raising their temperature to some suitable figure before hot mangling. It was considered that too much capacity was required to be obtained from extensions to the existing facilities, particularly as batch normalising entails excessive handling of plates, and it was decided that continuous normalising in the mill train was necessary.

The mill produces plates at an average rate of forty-two per hour and, when producing the lighter plates which require to be normalised or which would be improved by stress relief, rolling rates approaching sixty per hour are not infrequently reached. The normalising furnace thus had to be of such a length that a plate could be entered every minute and be in the furnace long enough to attain the required degree of heat-treatment. It had to be capable of working at widely variable temperatures, with rapid adjustment of temperature, and, therefore, fuel consumption, to suit different kinds of material and different degrees of heat-treatment. Consideration of rates of throughput led to the decision that the furnace could not be less than 200ft long, and a furnace of this length could not be accommodated in the existing mill train, nor indeed in the mill building. Finally, it was decided to install a furnace with internal dimensions of 200ft by 8ft, built by Gibbons Brothers, Ltd., Dudley, in a building erected by the constructional department of the Appleby-Frodingham Steel Company. The furnace came into operation in August last.

The furnace incorporates the Gibbons-Webb roof combustion principle. In this system, hot fuel gas from a recuperator is fed into the furnace through inlets on each side of the heating chamber just beneath the level of the furnace roof. The roof itself is perforated by numerous uniformly spaced small holes of equal diameter through which preheated air passes into the fuel gas below, thus producing small jets of flame of equal size and heat generating capacity. These jets burn vertically downwards and merge into one uniform " blanket " of flame, completely covering the furnace hearth. Air spaces or reservoirs are included in the furnace above the perforated roof into which the preheated air from recuperators is fed under fan pressure, subsequently flowing through the perforations in the furnace roof. Above the air reservoirs is the recuperator chamber housing both gas and air recuperator tubes. The waste gases from the heating chamber pass into the recuperator chamber through a series of controlled exit ports along each side of the furnace at hearth level. Each sectional recuperator tube has its own setting valve on the ingoing side of the tube, and a special valve for diverting the preheated air to atmosphere is fitted to the outgoing side of the air recuperator tubes.

The furnace is divided along its length into four zones each with its own separate gas and air valves, recuperators and main waste gas control. Each zone of the furnace is again divided into two sub-zones, and each sub-zone is separated into eleven smaller sections, each with its own gas and air setting valves and having its own recuperators, consisting of eight metal pipes in the form of " hairpins," surface treated to minimise the action of waste gas, fuel gas and air. The four zones each have their own automatically controlled gas, air and waste gas valves, and there are also hand-operated gas and air valves on each zone, and each sub-zone. A main gas valve is provided for emergency use for the complete furnace. Waste gases from each zone are collected in a brick-lined horizontal steel main on top of the furnace, and from there through a downcomer into an underground flue, through an induced draught fan into a brick-lined steel chimney. Easy access is provided to all gas and air valves by walkways and platforms running the whole length of the furnace. The sides of the furnace are protected by mild steel plates, and the ends are armoured with heavy cast iron panels. The hearth of the furnace is of monolithic construction carried on cast iron plates supported on steel sections, and is water-cooled by eight steel water pipes fed from the middle of the furnace and discharging at each end. The

furnace, which is well instrumented and controlled, is supplied through a 24in main with cold, clean blast-furnace gas at a pressure of between 4in and 6in w.g.

Plates leaving the 7ft mill are conveyed across a rail skid bank 80ft long by an overhead pusher to a roller table, from which they enter the furnace. They proceed through the furnace by a Gibbons-Law disc conveyor, which consists of eighty-eight transverse shafts, each carrying five discs, alternately staggered to left and right of the centre line so that the plates have ten lines of support. The transverse shafts or axles are mounted beneath the furnace hearth, in roller-bearing pedestals. The rims of the discs, on which the plates are conveyed, are of heat-resisting steel, and project through slots in the furnace hearth to ensure that the plates are well clear of the hearth. The disc shafts are coupled in groups of three or four by roller chains. Two such groups, coupled by chain drives to a worm reduction gear, form one driving unit. Twelve of these units are driven from a common layshaft extending along the length of the furnace. This shaft is coupled in turn by a chain drive to a P.I.V. unit and the main driving motor. The variable-speed gear provides a variation in conveying speed from 24ft to 38ft per minute. Twelve disc shafts at each end of the furnace are intermittently speeded up to provide rapid entry and exit of the plates, whilst the remaining disc shafts run at normal speed. This is accomplished by overdriving the end sections of the layshaft by separate motors. A differential system of couplings between the overdriven and normal speed sections of the layshaft is adopted, whereby either end section reverts to normal speed as soon as its overdrive is cut out. To obviate skidding of a fast moving plate on discs rotating at normal speed, seven disc shafts, successive to the twelve overdriven ones at the charge end of the furnace, are fitted with freewheels so that they can be overdriven by the weight of the plate moving over them. For the same reason, the seven shafts preceding the twelve overdriven ones at the discharge end are similarly equipped, and, in case the mangle speed exceeds the overdriven speed, the twelve overdriven disc shafts are also supplied with freewheels. The discs normally rotate in one direction only, but can be reversed and oscillated if necessary. The final sprockets and chains above floor level are enclosed in expanded metal guards, and the remaining gear and drives are below floor level. There is an inspection pit below the furnace hearth.

Plates are discharged from the furnace to a hot mangle situated very close to the furnace exit, and are flattened in one pass. From the outgoing mangle roller table, the plates are transferred to a return rack by a pusher similar to the one used for getting plates from the mill to the furnace. The return rack lies parallel to the furnace and is in three sections, the first and third sections being made up of solid rollers, and the middle section of disc rollers, all directly driven by independent motors. The plates are skidded on to a finger conveyor bank, equipped with turnover arms for inspection of both surfaces. From this bank the plates join the existing line for movement to the cooling and marking banks.

With the installation of this plant the Appleby-Frodingham Steel Company is now able to normalise, if necessary, the entire output of its 7ft plate mill, made up of plates varying in thickness from $\frac{1}{4}$in up to and including $\frac{3}{4}$in, in widths up to 78in, and up to 40ft in length. Plates not requiring normalising proceed through the hot mangle situated in the mill train.

(To be continued)

Naval Construction in 1952

By RAYMOND V. B. BLACKMAN

No. I

Great Britain

WARSHIPS under construction in Great Britain in 1952 fell broadly into two groups. The first group comprised the larger units, namely, aircraft carriers, cruisers and large destroyers, constituting the back-log of the second world war emergency programme, while the second group consisted of smaller vessels such as frigates, minesweepers, patrol boats and seaward defence vessels which were comparatively recently ordered under the rearmament programme. Interlocked with this new construction was a programme of conversion and modernisation.

The ships in the first group included the large fleet aircraft carriers "Ark Royal" and "Eagle," the intermediate fleet aircraft carriers "Albion," "Bulwark," "Centaur" and "Hermes"; the light fleet aircraft carriers "Hercules," "Leviathan" and "Powerful"; the cruisers "Blake," "Defence" and "Tiger," and the outsize destroyers "Dainty," "Daring," "Decoy," "Defender," "Delight," "Diamond," "Diana" and "Duchess." All these ships were ordered, and the majority begun, during the war.

H.M.S. "Eagle"

H.M.S. "Eagle"—see Plate 3—the heaviest aircraft carrier ever built in Great Britain, was finally accepted from the builders into Royal Naval Service on March 1, 1952. In the "Eagle," it is possible to handle larger and faster aircraft and to handle them more quickly and with greater ease than in any previous carrier of the Royal Navy. The two hangars in the "Eagle" are served by high-speed lifts. For launching her aircraft there are two catapults which are of a type more powerful than any the Royal Navy has hitherto used. The aircraft are positioned for loading into the catapults by an automatic device which greatly speeds up launching operations. The arrester gear is also of improved design which will accept landings by faster and heavier aircraft than any previously catapulted from carriers. A comprehensive system of flight deck lighting will make possible the operation of jet aircraft by night as well as by day.

The electrical installation of the "Eagle" has a total connected load of nearly 11,500kW. The generating plant consists of eight electrical generators, each of 500kW capacity. Four of these generators are steam driven and four diesel driven. A 220V d.c. watertight ring main system is used for the distribution of the electrical energy, and supplies are tapped off this ring at convenient points around the ship through some 300 electrically operated circuit breakers. An emergency supply system is fitted for use in the event of damage. Distribution of electricity is controlled from a central large switchboard and four smaller switchboards are provided for use in an emergency. From each of these the supplies to a quarter of the ship can be controlled. All switchboards are provided with an elaborate system of indication lights.

The "Eagle" is the first ship in the Royal Navy to have an automatic telephone exchange. It has 500 lines. There is also an integrated main broadcast system. Air conditioning is installed in important action positions and in mess spaces to improve the comfort and efficiency of a peacetime complement of eighty-eight officers and 1337 ratings, including the ship's air complement, but excluding the complements of embarked air squadrons. According to the 1952–53 Navy Estimates the estimated building cost of the "Eagle" is £15,795,000.

The "Eagle" was ordered on May 19, 1942, as part of the wartime construction programme. When she was laid down at the Belfast shipyard of Harland and Wolff, Ltd., on October 24, 1942, she was known as the "Audacious," but on January 21, 1946, she was renamed "Eagle" after a projected sister ship of that name, which had been ordered from Vickers-Armstrongs, Ltd., Tyne, had been cancelled. Now the largest aircraft carrier wearing the White Ensign, the new "Eagle" has a standard displacement of 36,800 tons, which is increased to approximately 46,000 tons at full load. With an overall length of 803ft 9in and a length between perpendiculars of 720ft, she has a beam of 112ft 9in and a maximum draught of 36ft. Her flight deck has an area of over 2 acres, from which the largest and heaviest naval aircraft in existence can operate. The maximum stowing capacity of the ship is 80 to 100 aircraft according to type and size. She is provided with a large number of specially fitted stores and workshops, and they are so arranged that all the spare parts for repairing, servicing and maintaining aircraft are close at hand.

The main propelling machinery of the "Eagle" comprises eight Admiralty boilers of the three-drum type, supplying superheated high-pressure steam to a four-shaft arrangement of Parsons single-reduction geared turbines, which develop an aggregate shaft horsepower variously estimated as between 150,000 and 167,000 s.h.p., although no designed or maximum figures have been released officially. The designed speed of the "Eagle" is approximately 31½ knots at deep-load draught. Several thousand tons of oil fuel are stored in tanks distributed throughout the length and breadth of the ship. The ship is reported to be particularly well protected with armoured sides, flight deck and magazines. The main armament comprises sixteen 4·5in dual-purpose guns disposed in eight twin turrets, and there is a secondary battery of no fewer than fifty-seven Bofors anti-aircraft weapons of 40mm calibre in multiple and single mountings. Electric welding was used on an unprecedented scale in the construction of the hull, a considerable amount of special research and investigation having been carried out in this connection. The ship is believed to embody the greatest application of electric welding to shipbuilding so far developed.

It is in the field of habitability perhaps that the greatest progress has been made in British warship design since before the war. The "Eagle" contains all the necessities and amenities for living in either tropical or Arctic climates for a full complement of up to 2000 officers and ratings, and has accommodation for a maximum of some 2750 personnel in wartime. The "Eagle" is the first British aircraft carrier to be equipped with a designed centralised mess. The ship has large dining halls, which are supplied from galleys containing up-to-date machinery and cooking equipment and, in place of the former broadside mess boards and stools, the mess decks are furnished with

tubular steel tables and chairs and settees.

The ship has a remarkably comprehensive compartmentation and a high degree of damage control. Any Admiralty would hesitate to describe a ship as unsinkable after the destruction of the German battleship "Bismarck," but the subdivision and damage control arrangements in the "Eagle" are so complete that it would require powerful and sustained underwater destructive efforts to sink her. Even the wardroom mess is divided into four sections by watertight bulkheads, so that there are two entirely separate eating spaces and two entirely separate bars with no connection between them, and officers have no option but to go to one or the other. The anteroom lounge is subdivided by a watertight bulkhead and access between each half, a late concession involving the piercing of the bulkhead, is by watertight doors.

H.M.S. "Ark Royal"

The only other large fleet aircraft carrier of the same class as the "Eagle" is the "Ark Royal," still under construction. She was scheduled to have been completed by this time, but various adjustments in design and modifications incorporated in her in the light of current or future requirements have delayed continuous and straightforward building and in fact she is still fitting out. Originally known as the "Irresistible," her name was changed to "Ark Royal" following the sinking of the former fleet aircraft carrier of that name. She was laid down on May 3, 1943, and launched from the Birkenhead slipway of Cammell Laird and Co., Ltd., exactly seven years to the day afterwards. She is now expected to be completed by the end of 1953 or early 1954. She will differ in many respects from the "Eagle," her construction having been intermittently arrested to allow later ideas and equipment to be embodied in her than in her original sister ship. And, like most of the newer British ships, provision has been made in her amended design for bunks instead of hammocks. There were to have been four large fleet aircraft carriers of the "Eagle" class, but the ship originally known as the "Eagle," and the "Africa" were cancelled at the end of the war.

Destroyers

Of the eight very large destroyers of the "Daring" class under construction at the beginning of the year, the first, the "Daring" herself, was completed and accepted into the Royal Navy from the builders on February 2, 1952. Built at the Tyneside yard of Swan, Hunter and Wigham Richardson, Ltd., of Wallsend, who were also responsible for the main propelling machinery, she gives her name to a class of fleet destroyers which are the largest ever built in Great Britain for the Royal Navy. The "Daring" was designed during the second world war for possible use against the Japanese. She was laid down on September 29, 1945, and launched on August 10, 1949. She is of all-welded construction and represents practically a new category of warship midway between that of light cruiser and destroyer.

The standard displacement is 2610 tons and the full-load displacement 3700 tons, the overall length 390ft, the length between perpendiculars 366ft, the beam, wide for a destroyer, 43ft, and the maximum draught of 12ft 6in.

The main propelling machinery of the "Daring," in the design and testing of which Pametrada played a very large part, is of advanced design. It comprises two sets of Parsons double-reduction geared steam turbines turning two shafts and unofficially reported to aggregate about 55,000 s.h.p., equal to a speed of 35 knots. The boilers were designed for superheat control and the steam conditions are the highest yet used in ships of the Royal Navy. The actual erection of the main engines and boilers, together with most of the associated auxiliary engines, was carried out by the Wallsend Slipway and Engineering Company, Ltd. The electrical installation is 220V d.c.

The main armament of the "Daring" consists of six dual-purpose guns of 4·5in calibre disposed in three sturdy and roomy twin turrets of the modern "square" shape, two forward and one aft. She also carries a secondary battery of six 40mm Bofors anti-aircraft weapons as well as ten 21in torpedo tubes arranged in two "pented" nests. The anti-submarine armament includes an improved squid of the horizontal, controlled mortar type, which can be trained, mounted on the quarter deck. As a squadron leader the "Daring" has a peacetime complement of 308, comprising 22 officers and 286 ratings, a number considerably larger than that of any destroyer previously commissioned and made necessary by the increasing amount of highly technical equipment carried in this new class of ship.

H.M.S. "Diamond"—see Plate 3—the second of the "Daring" class destroyers to be completed, was accepted by the Royal Navy from her builders, John Brown and Co., Ltd., Clydebank, a firm which also manufactured the main propelling machinery, at the end of February, 1952. She is in most respects similar to the "Daring," but her electrical plant differs from previous practice in ships of the Royal Navy, in that it is an a.c. installation operating at 440V, three-phase, 60 c/s. The third vessel of the "Daring" class, the "Duchess," was completed and accepted into service in November, 1952, when she arrived at Portsmouth from the Woolston Shipyard of her builders, John I. Thornycroft and Co., Ltd., Southampton. The "Duchess" is also an a.c. ship.

Four more "Daring" class destroyers are in an advanced stage of construction and are expected to be finished during the 1952/53 financial year. They are the "Decoy" (ex-"Dragon"), being completed by Yarrow and Co., Ltd., Glasgow, which was laid down on September 22, 1946, and launched from the Scotstoun Yard on March 29, 1949; the "Defender" (ex-"Dogstar"), expected to be accepted shortly from Alex. Stephen and Sons, Ltd., Govan, which was begun on March 22, 1949, and took the water at the Linthouse Yard on July 27, 1950; the "Dainty," being fitted out by J. Samuel White and Co., Ltd., Isle of Wight, who laid the keel on December 17, 1945, and sent her down the ways at the Cowes Shipyard on August 16, 1950; and the "Delight" (ex-"Disdain," ex-"Ypres"), being built by the Fairfield Shipbuilding and Engineering Company, Ltd., Glasgow, the construction of which was started on September 5, 1946, and which left the Govan slip on December 21, 1950. The eighth vessel of the "Daring" class, H.M.S. "Diana" (ex-"Druid"), which is under construction at the yard of Yarrow and Co., Ltd., Scotstoun, was laid down on April 3, 1947, and did not leave the stocks until May 8, 1952.

Although the "Daring" class ships represent the present zenith of destroyer evolution and development, in several respects they are experimental. In addition to the eight ships built and building in the British Isles for the Royal Navy, four destroyers of similar type are being built in Sydney and Melbourne for the Royal Australian Navy. According to the 1952/53 Navy Estimates, the "Daring" cost £2,221,000 and the "Diamond" £2,280,000.

Light Fleet Aircraft Carriers

Work continued in 1952 on the fitting out of three of the four light fleet aircraft carriers of the larger or intermediate size, known as the "Hermes" class, namely, the "Albion," "Bulwark" and "Centaur," which, with the long-delayed "Hermes" herself, formed part of the wartime construction programme. The "Albion," built by Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne, was laid down on March 23, 1944, and launched on May 6, 1947. The "Bulwark" and "Centaur" are both being built by Harland and Wolff, Ltd., Belfast. The former, having been begun on May 10, 1945, left the slip on June 22, 1948, while the latter, the keel of which was laid on May 30, 1944, took the water on April 22, 1947. The "Hermes" (ex-Elephant"), however, was still on the stocks at the end of 1952, although she was laid down by Vickers-Armstrongs, Ltd., Barrow-in-Furness, as long ago as June 30, 1944.

Initially conceived in the light fleet aircraft carrier category, these ships are considerably enlarged vessels with propelling machinery of nearly twice the power of the original light fleet carrier designed to give an increase in speed of about 5 knots, thus obviating the inherent faults of the inadequate 13,190 to 13,350-ton carrier with their speed of 23½ to 25 knots, and bringing them more into line with modern fleet aircraft carrier requirements. But further improvements in the design since they were first projected have considerably increased the original displacement of 18,300 tons. With an overall length of 737ft 6in and a length between perpendiculars of 650ft, the ships of the "Hermes" class have a hull beam of 90ft and a maximum draught of 26ft 6in. The main propelling machinery consists of a two-shaft arrangement of Parsons geared turbines taking steam from Admiralty three-drum boilers and unofficially reported to have been designed for some 75,000 s.h.p., equal to a speed of over 29 knots. The ships were designed to carry about forty-five aircraft, and their armament includes thirty-two 40mm Bofors A.A. weapons and four three-pounder saluting guns. They will each have a complement of about 1400 officers and ratings. Turning to three other vessels constituting a back-log of the wartime construction programme, namely, the three light fleet aircraft carriers of the "Hercules" class: no work was done during 1952 on the "Hercules" and "Leviathan," but work on the "Powerful" is now being resumed. The keel of the "Powerful" was laid on November 27, 1943, at the Belfast yard of Harland and Wolff, Ltd. She left the stocks on February 27, 1945, and her construction continued until she was very nearly completed, but, as in the case of her two sister ships, her construction was suspended in May, 1946. Her contract was cancelled and she was laid up at Belfast. But in July last year, it was announced that she would be completed and transferred to the Royal Canadian Navy.

The "Hercules" class ships were designed for a standard displacement of 14,000 tons with a full load displacement of 19,000 tons, an overall length of 695ft with a length between perpendiculars of 630ft, a hull beam of 80ft, an extreme width of 112ft 6in, and a draught of 24ft. The main propelling machinery consists of a two-shaft arrangement of Parsons single-reduction geared turbines supplied with steam from four Admiralty three-drum boilers designed for a working pressure of 400 lb and 700 deg.

maximum superheat. The plant is unusual in that contrary to the usual practice of separate engine-rooms and boiler-rooms, there are two machinery spaces each containing a set of turbines and two boilers side by side, the turbines being arranged *en echelon* so that the starboard propeller shaft is longer than the port. The machinery was designed to develop 40,000 s.h.p., equal to a maximum speed of about 24½ knots. The capacity of each ship is thirty-five aircraft, and the armament includes twenty-eight 40mm A.A. Bofors guns in six twin and sixteen single mountings.

Cruisers

It was officially stated last March that the cruisers of the "Tiger" class remained suspended while awaiting further developments of armament and fire control. The keel of the "Tiger" was laid at the Clydebank yard of John Brown and Co., Ltd., as long ago as October 1, 1941, but she was not ready for launching until the war was over. She actually slid down the ways on October 25, 1945, and soon afterwards her construction was stopped and she was laid up at Dalmuir, Scotland. The "Defence" was begun by Scott's Shipbuilding and Engineering Company Ltd., Greenock, on June 24, 1942, and she took the water on September 2, 1944. When she was approaching completion, however, work on her further construction was suspended in July, 1946, her contract was cancelled, and she has been laid up in the Gareloch, off the Firth of Clyde, ever since. The "Blake" was laid down by the Fairfield Shipbuilding and Engineering Company, Ltd., Govan, Glasgow, on August 17, 1942, and she left the slip on December 20, 1945, but her construction was also suspended in 1946.

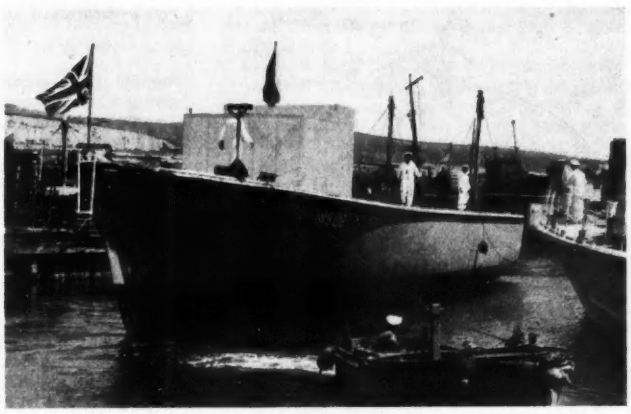
According to the 1952–53 Navy Estimates, while the actual material construction of these ships was suspended, work in relation to the preparation of equipment was being progressed. It was stated that the armament of the vessels was under review and that the future fitting out of all three was dependent on research then being carried out. It is understood that, when completed to the recast design, the "Tiger" class will have a displacement of over 9,500 tons standard and about 11,750 tons full load.

Frigates and Minesweepers

Turning to the post-war naval rearmament programme initiated some two to three years ago, the new ships under construction are principally frigates and minesweepers. The frigates are of four differing types corresponding to the roles required of them. There are two types for anti-submarine work, a third type for anti-aircraft duties, and a fourth for aircraft direction. But the greater part of the frigate programme consists of anti-submarine frigates of both types, of different striking power. These will be complementary to each other and the simpler class of vessel will be produced in larger numbers for the same expenditure in resources. The anti-submarine frigates will be equipped with the latest developments in apparatus and weapons capable of hunting and killing underwater craft. H.M.S. "Salisbury," the first frigate of the aircraft direction type, was laid down in H.M. Dockyard, Devonport, on January 23, 1952.

Two anti-aircraft frigates are to be built. The first of these, the "Lynx," was taken in hand at Clydebank by John Brown and Co., Ltd., the main propelling machinery having been ordered from Vickers-Armstrongs, Ltd., Barrow-in-Furness. The second, the "Leopard," which was to have been built at Devonport, was subsequently allocated to Portsmouth, but although she was listed in the 1952–53 Navy Estimates under the ships which would be "in course of construction," but not launched, on March 31, 1952, there is no sign of her keel being laid at the time of writing. British Polar Engines, Ltd., Glasgow, would be responsible for the propelling machinery, it was officially stated, but the allocation of machinery between the above three ships under construction at Devonport, Clydebank and Portsmouth is provisional and may be subject to modification.

Three of the frigates of the "utility" or simpler anti-submarine type are the "Scarborough," to be built by Vickers-Armstrongs, Ltd., the hull at Newcastle upon Tyne and the propelling machinery at Barrow-in-Furness; the "Torquay," ordered late in 1951 from Harland and Wolff, Ltd., Belfast, with main engines manufactured by Vickers-Armstrongs, Barrow; and the "Whitby," which was ordered early in 1951 from Cammell Laird and Co., Ltd., Birkenhead, which is also manufacturing the main machinery. The "Scarborough" and others are to have diesel engines.



"IMS 05" British New Minesweeper

Four of the frigates of the fast, comprehensively equipped, hunter-killer type have also been ordered. The "Pellew" is being built by Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne, the propelling machinery being manufactured by the Wallsend Slipway and Engineering Company, Ltd., while the "Murray" is under construction at the Linthouse yard of Alex. Stephen and Sons, Ltd., Govan, Glasgow, which is also responsible for the main engines. The "Hardy" and "Keppel" are being built and engined by Yarrow and Co., Ltd., Scotstoun.

A large number of coastal and inshore minesweepers of new designs have been ordered and many are already on the stocks. The first from each of a number of shipyards should be completed before the end of the 1952–53 financial year. Some orders for the new kinds of minesweepers have been placed with firms which are not normally asked to undertake naval work. Some sixty-five vessels were mentioned in the latest official list.

These coastal minesweepers have a length of 152ft with a beam of 28ft 9in and will be armed with three small guns. They will have high-speed diesel engines turning two shafts. Their construction involves aluminium for the framing and structural castings, the outer bottom being wood planked. The ships will operate sweeps against both contact and influence type mines, that is they will be able to deal with mines operated magnetically and acoustically. The hulls of these new minesweepers, being of similar design, are capable of rapid prefabrication. Their diesel engines are also standardised to simplify the maintenance problem. The term "coastal minesweeper" signifies that they will be capable of operation in shallow coastal waters and distinguishes them from inshore minesweepers for shallow estuarial waters.

The thirty-five inshore minesweepers being built are considerably smaller craft, as illustrated. They are 106ft 5in in length with a beam of 20ft 6in; the craft are designed to operate in shallow waters, such as rivers and estuaries. They are an entirely new type of vessel and embody novel ideas resulting from lessons learned during the war and in the course of subsequent developments. In addition to minesweeping equipment each will mount one small gun.

Motor Torpedo Boats

The first of a new class of motor torpedo boats officially described as "Her Majesty's M.T.B.s 'Gay Archer' and 'Gay Bombardier,'" were launched at the Portsmouth yard of Vospers, Ltd., last August. With a length of 75ft 2in and a beam of 19ft 8in, they mount two 21in above-water torpedo tubes and one small gun. They are almost entirely of wooden construction. They are driven by petrol engines. Previous boats of this kind came out at 50 tons displacement and developed about 4000 b.h.p., equal to a speed of 40 knots.

In addition to these craft of older design, two experimental boats were finished towards the end of the year. Now named "Bold Pathfinder" and "Bold Pioneer," they are the first two motor torpedo boats of the Royal Navy to be designed for gas turbine propulsion in combination with diesel engines. These craft, although not identical by any means, are nevertheless, according to the Admiralty, largely sister ships. Both craft are fitted with gas turbines manufactured by the Metropolitan-Vickers Electrical Company, Ltd., of Manchester, the main propelling machinery installation having been undertaken in each case by their builders. Their gas turbines of 4500 h.p. were developed from the "Gatric" engine, which operated so successfully in M.T.B. 5559 (ex-M.G.B. 2009) in 1947. Each vessel is armed with four 21in torpedo tubes and a 4·5in gun and carries a peacetime complement of two officers and sixteen ratings. The two boats are known as convertibles, and can serve as motor torpedo boats or motor gunboats.

The "Bold Pathfinder," which is of round bilge form, was built at the Portchester yard of Vosper's, Ltd., at a cost of £330,000. She has twin funnels of almost square section. With an overall length of 122ft 8in and a length between perpendiculars of 117ft, she has a beam of 20ft 5in and a maximum draught of 6ft 7in. But the "Bold Pioneer" is of hard chine form. She was built at the Cowes shipyard of J. Samuel White and Co., Ltd., Isle of Wight, at a cost of £260,000. She has an overall length of 25ft 6in and she draws 6ft 10in of water at deep load.

(*To be continued*)

Contemporary Methods of Watch Production*

By R. A. FELL, M.A.,† and P. INDERMUHLE, A.M.I.Mech.E.‡

No. I

PORTABLE timekeepers became a possibility in about 1500, when Henlein, a Nuremberg locksmith, introduced the mainspring. These early watches used a very rudimentary oscillating system consisting of a balance without a spring, the restoring couple being supplied by the mainspring through the wheel train and verge escapement. The restoring couple was bound to vary with the state of winding of the mainspring, the wear in wheel train and pivots, and the condition of the oil ; so the early watches were naturally poor timekeepers.

A vital development was the introduction of the balance spring in about 1660 by Robert Hooke or Christiaan Huygens. The oscillating system was thus given a properly defined periodic time and, even with the small amplitude and high frictional constraint due to the verge escapement, timekeeping was improved to give an error of about 0·3 per cent, or less than five minutes per day.

During the next hundred years the cylinder, duplex, chronometer, and lever escapements were developed to allow a larger amplitude of oscillation and to free the balance and spring as far as possible from frictional constraint. The chronometer escapement probably offers the least variable constraint, but it is not suitable for watches intended to be worn or carried. The lever escapement is used universally to-day in all good-grade watches. It was first made in some approximation to its modern form by Thomas Mudge in 1765. Further developments by Emery and Breguet left it very nearly as it is to-day.

Temperature errors were probably recognised by 1700, and attempts to compensate for them were made, notably by John Harrison and Pierre Leroy. By 1800 the bimetallic balance had been perfected by Arnold and Earnshaw ; it allowed the loss of elasticity of a steel spring with rise of temperature to be compensated by a reduction in the moment of inertia of the balance. A number of refinements were introduced for marine chronometer balances during the nineteenth century ; but the development by Dr. C. E. Guillaume in about 1912 of a spring material with a low temperature coefficient of elasticity was an important step in commercial timekeeping, as it enabled good performance to be obtained with a mono-metallic balance. This material, named "Elinvar," is also much less affected by magnetism than steel and is resistant to rust. Guillaume's work served as the starting point for the development of similar alloys with better elastic properties.

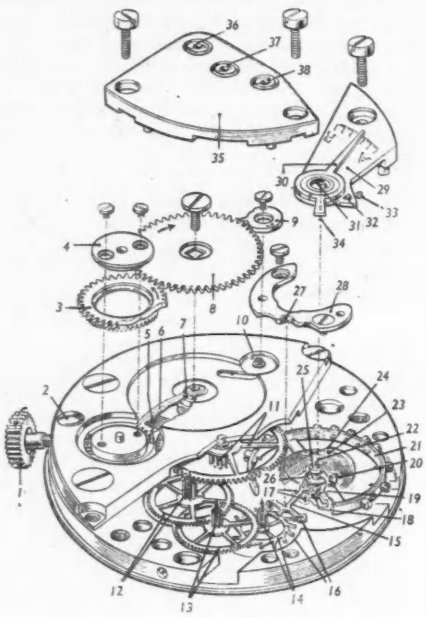
* Paper. Institution of Mechanical Engineers, December 19, 1952.

† Consultant.

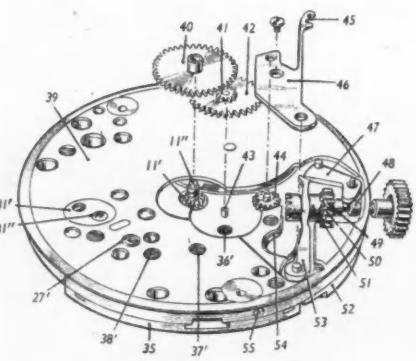
‡ Technical manager, Cyma Watch Company, Ltd.

THE DESIGN OF A MODERN WRIST-WATCH

Watches contain an oscillating system consisting of a balance, possessing moment of inertia and a balance spring, or "hairspring," which gives a restoring couple depending on the displacement of the system from its mean position. The controlling system requires energy to maintain it in oscillation ; this is stored in the mainspring, which is coiled inside the barrel. The energy is transmitted to the balance through the wheel train and escapement. The movement of a typical modern wrist-watch can be seen in detail in Fig. 1.



Train side of movement



Dial side of movement

1. Winding button.
2. Setting lever screw.
3. Crown wheel.
4. Crown wheel centre.
5. Mainspring.
6. Barrel.
7. Barrel arbor.
8. Ratchet wheel.
9. Clock.
10. Click spring.
11. Centre wheel and pinion.
12. Third wheel and pinion.
13. Fourth wheel and pinion.
14. Escape wheel and pinion.
15. Lever.
16. Pallet stones.
17. Banking pins.
18. Lower end stone.
19. Lower balance jewel.
20. Stud.
21. Balance.
22. Balance staff.
23. Balance spring.
24. Overcoil.
25. Collet.
26. Roller.
27. Upper pallet staff jewel.
28. Pallet bridge.
29. Balance cock.
30. Regulator index.
31. Upper end stone.
32. Stud hole.
33. Stud screw.
34. Curb pins.
35. Train bridge.
36. Upper third-wheel jewel.
37. Upper fourth-wheel jewel.
38. Upper escape-wheel jewel.
11'. Cannon pinion.
11". Centre pinion extension.
27'. Lower pallet staff jewel.
31'. Lower end piece.
31". Lower end stone.
36'. Lower third-wheel jewel.
37'. Lower fourth-wheel jewel.
38'. Lower escape-wheel jewel.
39. Pillar plate.
40. Hour wheel.
41. Minute pinion.
42. Minute wheel.
43. Minute wheel stud.
44. Transmission wheel.
45. Jumper.
46. Keyless cover.
47. Setting lever.
48. Winding stem.
49. Winding pinion.
50. Clutch teeth.
51. Sliding pinion.
52. Barrel bridge.
53. Return arm.
54. Return arm spring.
55. Dial screw.

Fig. 1—*Movement*

The wheel train also serves to convert the relatively rapid movements of the balance and spring into the slow movement of the minute hand. The escapement delivers energy to the balance and spring in correctly phased impulses, so maintaining it in oscillation. Each time the escapement is released—that is every half-cycle with a lever escapement—the wheel train turns forward carrying the hands with it. The movement of the hands is thus controlled by that of the oscillating system.

A balance and spring with a periodic time of 0·4 second is normally used, and has to be maintained at an amplitude of between about 200 deg. and 300 deg. Since the size of the movement (commonly about 1·1in diameter) limits the volume of the mainspring barrel, it limits also the amount of energy that can be stored in the watch ; it is therefore necessary to choose a balance of suitable dimensions in relation to the barrel.

The energy is transmitted to the escapement through a train of four pairs of wheels (known as the "going train"), giving a step-up ratio of about 4200 : 1. This gives an average ratio of about 8 : 1 for each pair, and considerations of space render it essential to use low-numbered pinions (six to ten leaves). A special form of gearing is called for, and up to the present it has been developed from the following basis (Fig. 2). The pinion has hypocycloidal dedenda with relatively short addenda, so that as much of the action as possible occurs after the line of centres. The hypocycloid used is a special case produced by a generating circle of a diameter equal to half that of the pitch circle of the pinion. The wheel addendum is based on an epicycloidal form, produced by rolling the generating circle used for the pinion on the pitch circle of the wheel. In practice, a corrected form is used, since the theoretical form is very sensitive to manufacturing errors.

The smallest pinion in a man's wrist-watch would have seven leaves of about 0·11mm

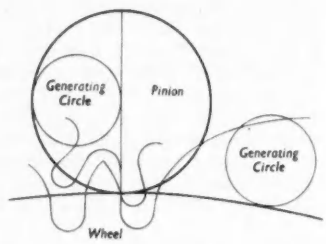


Fig. 2—*Generation of Wheel and Pinion for "Going Train"*

module (220 diametral pitch approximately), giving a tip diameter of some 0·9mm (0·036in). The tip diameter of a six-leaf pinion for a very small watch for a lady would be about 0·5mm (0·02in), with a module of 0·07mm (350 diametral pitch approximately) and a root diameter of about 0·18mm (0·0072in).

The centre wheel rotates once an hour and carries the cannon pinion on the dial side of the movement ; this is mounted friction-tight to allow of hand setting, and drives the motion work, which ends in the hour wheel that carries the hour hand. The keyless mechanism connects the winding button to either the cannon pinion or the barrel arbor, as required. The fourth wheel commonly rotates once per minute, and its lower pivot can be extended to carry the seconds hand.

The escape pinion is driven by the fourth wheel and carries the escape wheel. To-day, lever escape wheels are of the club-toothed type.

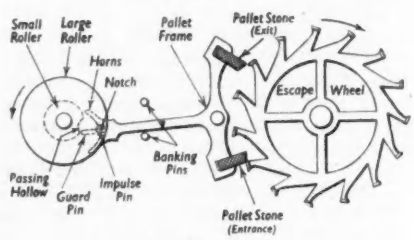


Fig. 3—*Lever Escapement*

The wheel acts with the locking and impulse faces of both pallet stones, which are mounted in the pallet frame or lever. Connection between the balance and pallets is effected by the action of the fork and roller. In Fig. 3 the impulse pin on the large roller has just picked up the notch and begun to rotate the pallets in a clockwise direction, thus withdrawing the pallet stone from under the locked tooth. When coincidence between the locking corners of stone and tooth occurs, the wheel will begin to turn forward and deliver impulse to the pallet stone, and thence, through the notch and impulse pin, to the balance.

When the tooth and stone separate, another tooth will drop on to the locking face of the second, or exit, pallet. This face is so inclined that a "draw" couple will be produced, tending to pull the lever over against its banking pin and to hold it there until the balance swings back and the impulse pin again picks up the notch. The

horns and guard pin act, with the impulse pin and small roller respectively, to prevent the pallets from moving across to the other banking pin if a shock is received when the impulse pin is not engaged with the notch ; this is known as the safety action. The provision of draw keeps the safety action from operating, and producing uncertain constraint on the balance, unless the watch receives a considerable shock.

The balance in a typical man's wrist-watch weighs about 100 milligrammes, and is mounted on a staff with cylindrical pivots. These pivots are merged into curved-sided cones for strength, as their diameter is only about 0·10mm (0·004in) ; axial location is effected by the bearing of their domed ends on flat end-stones. The holes in the bearing jewels are " olived " in work of a good grade (Fig. 4) ; this reduces the effects of viscous oil and of errors in the vertical alignment of the staff, and allows a closer fit to be used. The upper side of the jewel

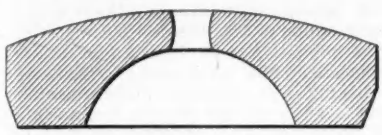


Fig. 4—Balance Jewel with Olived Hole

is convex and critically spaced from the end-stone ; this enables a small quantity of oil (about 0·005 milligrammes) to be held by surface tension. Correctly applied, it will lubricate the pivot for up to two years.

The train wheel pivots normally run in straight-sided jewel holes, axial location being afforded by the pivot shoulder and the flat part of the jewel. In very high-grade movements the escape pinion and even the pallet staff are provided with end-stones, and the centre holes are sometimes jewelled.

Watch Production

The Plates and Bridges.—The production of the pillar plate or " bottom plate " (Fig. 5) and bridges of a watch involves many operations. There is no standard sequence, and the technique varies among countries and firms.

These components are usually made from brass strip, the thickness of which must be kept within close limits. The tolerance in thickness is commonly 0·02mm (0·0008in).

The series of some sixty-two operations for a pillar plate, as planned in a British factory, begins with the blanking of the component out of the

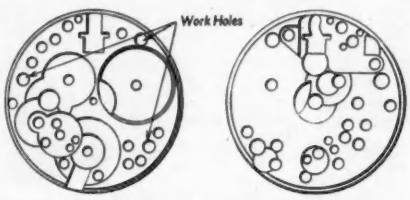


Fig. 5—Pillar Plate

strip on a power-feed press. This is followed by stress relieving and facing. The three work holes are then pierced ; they will serve as the basis of location for all subsequent operations.

The components are then divided into batches and will remain so till finally assembled. The operations may be grouped as follows :—

(a) *Presswork.*—Two-pillar die sets are universally used. On simple blanking tools the punch is located in the upper part of the set, the die being in the bottom part, which is fixed. The blank is ejected through the die. On compound blanking and piercing tools the component is pushed back into the strip by the ejector.

Blanks are in many cases shaved or " repassed " through a die smaller than the blanking die, to obtain greater accuracy in contour and clean edges. The amount of metal removed by the shaving tool is about 0·1mm (0·004in) all round.

For appearance's sake, the upper edges of the bridges may be bevelled ; the bevelling may be done under the press by forcing the component into a blind die with a polished bevelled contour.

In blanking tools for watch parts there is no clearance between punch and die, the punch being a push fit in the die. This necessitates the highest possible accuracy in the die set and all parts of the tool.

Two methods of making the die and punch are practised. By the first, a replica of the part to be produced is made from tool steel, hardened, and gradually drifted through the roughed-out die, which has been left with an excess of metal all round. Between each drifting the burrs raised are carefully removed, and the process is continued until the master part passes right through the die. The die is then hardened and used to shave the contour of the roughed-out punch, both being mounted on the die set. The punch is subsequently hardened. The die may be 25mm (1in) thick or more, according to its size ; but the working part is only about 5mm (0·2in) deep and the remainder is opened out slightly to clear the components.

In the second and more modern method the die —which is split up into two or more segments— is first roughed out and then hardened. The segments are then profile-ground on a pantograph machine. This procedure eliminates the risk of hardening distortion in the die and secures an excellent surface finish. The punch is made as described in the first method. Where the volume of production warrants it the die is now sometimes made in tungsten carbide, ground on one of the pantograph machines with a special diamond wheel.

In tools used to pierce holes in accurately defined positions it will be necessary to jig-bore the die. However, it is almost certain that the accuracy of location will be impaired during hardening. This must be corrected by grinding ; two methods are currently used. In the first, the holes are plugged ; the plugs spotted on the jig-borer or on a measuring machine ; each spot in turn is centred on a lathe face-plate with a microscope ; the plug is drilled out and the hole is ground. Special face plates on demountable quills are often used, as they are never taken off their spindles and are therefore more accurate than a normal lathe face plate. Holes smaller than 1mm (0·04in) can be corrected in this way, and the method is fundamentally accurate. When grinding holes smaller than about 2mm (0·08in) the problem of obtaining sufficient peripheral speed on the grinding pin becomes acute. Belt drives and compressed air turbines have been used at speeds of 20,000–50,000 r.p.m. Recently, however, small grinding quills driven by high-frequency three-phase motors have been introduced, some of which can run at 120,000 r.p.m. Grinding is carried out with a steel pin charged with diamond powder. In the second method, a jig grinding machine, shown in Fig. 6, which was recently introduced for finishing holes after hardening, has found considerable favour. Jig boring and grinding machines differ only in their spindles ; the one having a boring head, the other an air-driven wheel head rotating inside a revolving spindle—after the fashion of an internal planetary gear.

The punch shaper, which was specially developed for press tool making, saves much time. It is similar in principle to a vertical milling machine equipped with a rotary table and slotting head. At the bottom of its stroke the tool is progressively withdrawn, leaving a suitable radius on the punch to reinforce it and merge it with the shank. The operator watches the progress of the work with a microscope centred on the cutting edge of the tool, keeping the marked-out contour of the punch on the cross wires of the microscope by means of handles controlling the two slides and rotary table. When marking out, the necessary amount of material must be left for shaving the punch through the die. If the punch contour is complicated, marking-out is effected by coating the face of the punch blank with a layer of solder ; the blank is then mounted on the upper part of the die set and brought down

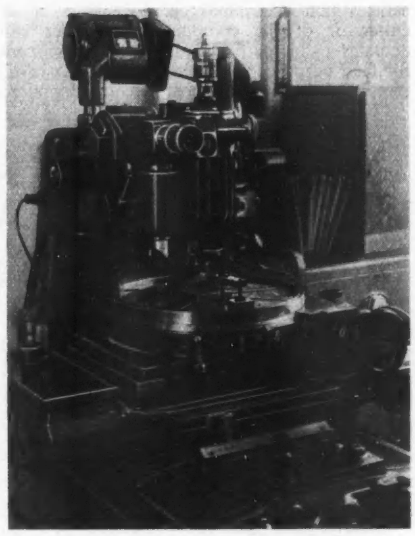


Fig. 6—Jig Grinder

on the die, which will leave an impression of its contour on the end of the punch blank.

(b) *Recessing.*—Several recesses of various shapes and depths have to be machined in the original brass blank to accommodate the wheel train, keyless mechanism, barrel, balance, &c. Circular recesses might be turned on small special-purpose face-plate lathes or on automatic recess turning machines, such as the duplex plate facer shown in Fig. 7. During the turning operation the blank is located on a special face plate by pins which enter its three work holes. On automatic machines the movements of the

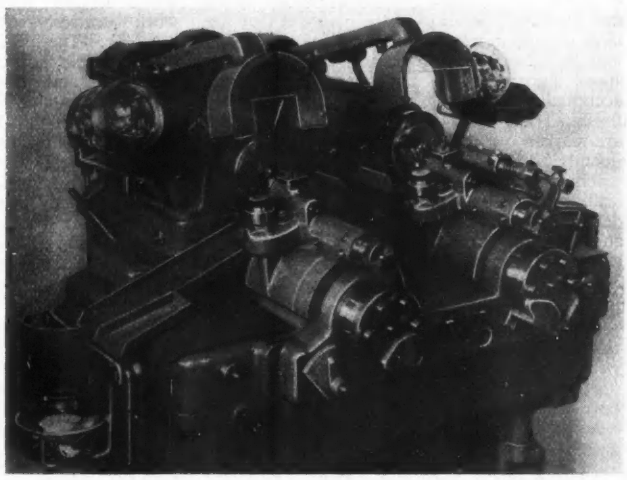


Fig. 7—Duplex Plate Facer

tool slides are controlled by cams ; the depths of the recesses, and in some machines their diameters, are controlled by micrometer stops. These high-speed automatic recessing machines are easily set up and the contour of the cam (or cams) is simple.

Specially designed automatic milling machines are used for non-circular, and sometimes for circular, recesses. Apart from certain recessing machines with vertical milling spindles, these machines are generally horizontal. One of the latest, which is illustrated in Fig. 8, has two

spindles actuated by the same set of cams, and machines two components simultaneously. One of the spindles may be used for roughing out and the other for finishing, the first cutter being slightly smaller than the second. Small single-tooth tungsten carbide end mills are used on machines of this kind. Nearly all machines of this type work on the basis of rectangular co-ordinates. Two slides at right angles, in a plane parallel to the component, are actuated by plate cams which determine the movements of the cutter or of the component. Another cam actuates a slide perpendicular to the component, for feed purposes ; but the actual depth of the recess is determined on most machines by micro-meter stops. Since there may be as many as nine depth stops, a fourth cam is used for indexing purposes.

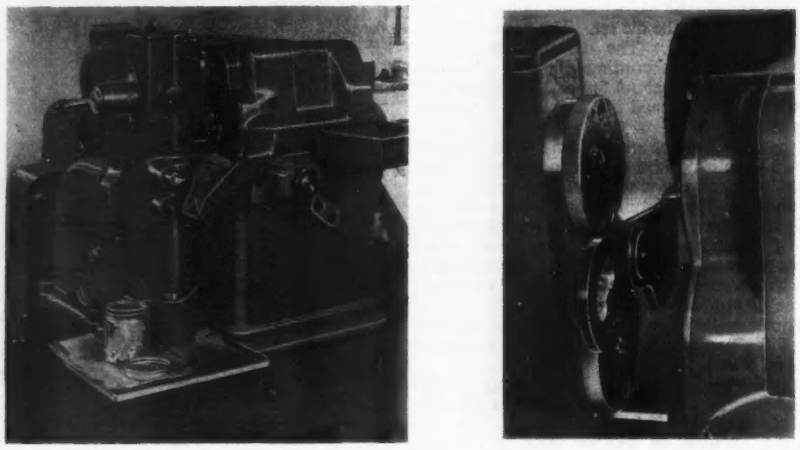


Fig. 8—Recessing Machine (Left) Showing Close-up of Work Plates (Right)

The output of such machines is high and they are capable of milling the most intricate contours, including those involved in the engraving of letters and figures. The recesses on the front of the plate are machined in sixty-nine seconds, and those of the back in thirty-five seconds ; two plates being worked simultaneously.

(c) *Hole Determination.*—The method selected for this operation varies according to the type of production. Some holes are pierced in the first blanking operation of the plates, if they are large enough in relation to their thickness. They may be shaved in a " repassing " tool at a later stage, particularly if they have to be very accurately placed and require a good surface finish. Train wheel holes, steady pin holes, &c., are marked out with a pricking tool and subsequently drilled on sensitive bench drilling machines, or on specially designed automatic drilling machines. There appears to be no definite rule why some holes should be pierced and others pricked and drilled. Size may be the guiding principle in a few cases ; for instance, 3mm ($\frac{1}{8}$in) holes in steel plates about 0·3mm ($\frac{3}{64}$in) thick are more conveniently and economically pierced than drilled.

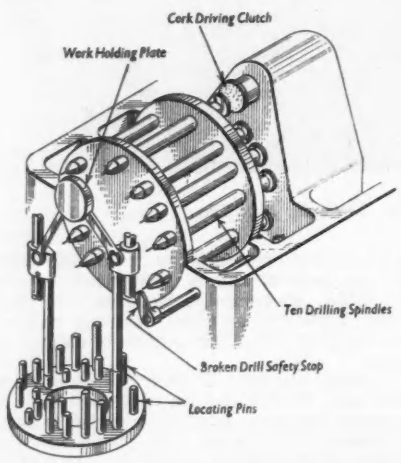


Fig. 9—Principle of an Automatic Drilling Machine

The technique is constantly changing with progress in machine tool design ; owing to recent developments in automatic drills the present trend is definitely in their direction. The latest of these automatic machines, shown diagrammatically in Fig. 9, has ten drilling spindles mounted on a turret with horizontal axis. Only the spindle in the top position is revolving at any one time, and it is driven at 10,000 r.p.m. by a cork disc clutch. The component is held in the workhead and brought into position by a system of cam rods and levers. Safety and interlocking devices protect the machine against such accidents as broken drills. The machine can drill up to fifty-six holes and the maximum rate of drilling is sixty holes per minute. A 1mm flat drill is capable of drilling over 200,000 holes in brass without failure.

The accuracy of location of the holes obtained with an automatic drilling machine of this kind is about 0·01mm (0·0004in). While this is sufficiently good for, say, screw holes, which do not have to locate the various components relative to one another, it is not satisfactory for the location of the train wheel centres, motion work centres, steady pins, &c. The location of steady pin holes, in both plates and bridges, is of paramount importance, since it determines whether the arbors will be upright. These holes are therefore drilled about $\frac{1}{10}$mm undersize on the automatic drilling machine; they are subsequently brought to their final position and size by shaving on a special press tool. In a tool of this kind location of the blank is effected by three pins which enter the work holes. Flat-faced punches of the exact size of the finished hole are located in a punch plate made with the greatest care. The location of the punches relative to one another should be to within 0·0025mm (0·0001in), as on the accuracy with which they are placed depends the accuracy and interchangeability of the finished components.

It is most important that the holes intended to receive jewels be truly to size and well finished, as these are an interference fit, the interference allowed usually being 0·01–0·015mm (0·0004–0·0006in). The jewels are subsequently inserted with a special jewelling press.

The screw holes may be tapped on an automatic machine basically similar to the drilling machine, if the output warrants it.

(d) *Finishing.*—The plate, being now completely machined, may be faced down finally to its exact thickness on a shaving machine or by diamond turning. Not more than 0·01–0·02mm (0·0004–0·0008in) is removed in this operation. In the shaving process the plate is held in a stationary fixture while six straight tungsten carbide knife-edges, mounted radially to a vertical spindle, rotate slowly over it, removing the necessary amount of metal and leaving a highly polished surface. The component is now ready for plating.

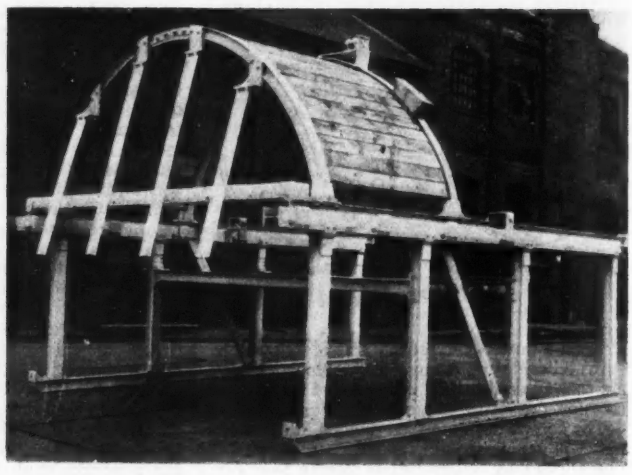
(To be continued)

A Gatehead Protective Canopy

An award was recently made by the National Coal Board to Mr. C. Round, now a sub-area manager in the East Midlands Division, and Mr. C. K. Woodhead, a fitter at Gedling Colliery, for the invention of a mobile device designed to give better protection to men engaged on the work of taking down rock when extending roadways into a coal face. The gatehead where roads join the coal face is a difficult place to support in mines and there is always a danger of accidents due to falling debris. Hitherto temporary support, to protect the men engaged in erecting permanent roadway supports, has been effected by suspending cantilevered girders from the nearest roadway steel arches and making a roof of planks across them, the ripping face being supported by steel bars or telescopic struts. Many forms of such temporary support have been used, but they did not give adequate protection from falls of the sides of the rippings.

The new supporting device, or ripping lip canopy, gives support to both roof and sides and it provides adequate protection for workmen until all debris has been removed and the roadway arch set. The construction of the new device—now known as the " Gedling Gatehead Safety Canopy "—is shown below.

It consists of a rigid frame base of structural steel members mounted on skids. The upper longitudinal members of this base are arranged with their webs in a horizontal position so that they provide channel slideways for the side supporting members of the canopy or shield proper. The shield itself consists of a pair of long-base beams having at one end two steel arches supporting a shield of heavy timber slats.



Gedling Gatehead Safety Canopy

After shot firing the canopy is slid forwards on the base to extend into the unsupported area, and whilst it gives protection against falls from the roof, hinged bars along the front press against the ripping face to prevent falls there. As the canopy advances the permanent roof supports of the road are set up immediately behind the shield.

Four of these canopies (costing about £90 each, including erection) are in use at Gedling Colliery.

Industrial and Labour Notes

Britain's Overseas Trade

The final figures relating to Britain's overseas trade in November were published by the Board of Trade just before Christmas. They show that exports of United Kingdom goods were valued at £207,201,000, which was about £11,600,000 below the figure for October. As, however, there were two less working days in November, the daily rate of export was 2 per cent higher than in October.

Taking the two months, October and November, together, the Board of Trade says that exports of engineering products were valued at £85,000,000 a month, which was £4,000,000 below the monthly average in the second quarter of last year. The vehicles group of exports, which includes locomotives, ships and aircraft, accounted for much of the decline in October and November, exports of cars, commercial vehicles, tractors and parts averaging about £21,500,000 a month compared with £25,000,000 a month in the second quarter. Machinery exports averaged £35,000,000 a month, which was also lower than the second quarter average. On the other hand, exports of iron and steel in October and November averaged £18,000,000 a month, which was £2,000,000 above the monthly average in the second quarter, and shipments of non-ferrous metals, at £7,000,000 a month, regained the second quarter's level. Coal exports in October and November were valued at just over £5,000,000 a month and showed little change from the monthly average of the third quarter.

The final figure given for the value of imports in November is £261,796,000, compared with an average monthly value of £292,410,000 in the period January to November, 1952. There was a drop in the quantities of ores and scrap of iron and non-ferrous metals imported in November, and imports of iron and steel and non-ferrous metals were lower than in October. Imports of machinery in November, however, though lower than in October, were above the monthly average over the first nine months of last year.

Restrictive Practices

The Board of Trade has recently announced that the Monopolies and Restrictive Practices Commission is to submit a report on the general effect on the public interest of "certain practices." These practices have been specified in a Board of Trade requirement, and relate to various arrangements which are made collectively—that is, by agreement among a number of traders—although such agreement is not one that is legally enforceable.

Examples covered by the Board of Trade requirement include arrangements between a number of traders, by virtue of which suppliers of goods confine the offer of supplies, or of "trade terms" or wholesale terms or other favourable prices or rates of discount or rebate, to particular classes of persons, whether such persons are described in general terms or listed by name; suppliers of goods withhold supplies, or trade terms or wholesale terms or other favourable prices or rates of discount or rebate, from particular classes of person, or from persons named in a "black list," "stop list" or other list; purchasers discriminate in similar ways in favour of, or against, certain suppliers or classes of supplier when placing their orders (including cases where suppliers and purchasers arrange to discriminate mutually in each other's favour), or rebates are paid or received by reference to the aggregate of purchases from a number of suppliers.

The Monopolies and Restrictive Practices Commission already has at its disposal a certain amount of information about the operation of some of the practices specified in the requirement, but it will, nevertheless, need to supplement that evidence and bring it up to date. Accordingly, the Commission invites persons and organisations which are affected by, or operate, any of the specified practices to submit factual information and views on the subject. Those who wish to submit such evidence are asked to inform the Commission as soon as possible of their intention to do so, explaining briefly their interest in the matter and when they expect their detailed evidence to be ready. All communications should be sent to the Monopolies and Restrictive Practices Commission, 3, Cornwall Terrace, Regent's Park, London, N.W.1.

Aluminium

The Ministry of Materials and the Ministry of Supply have announced that with the expiration of the current contract with the British Aluminium Company, Ltd., it has been decided to discontinue the arrangement under which the Ministry of Materials buys the British Aluminium Company's output of virgin aluminium for resale with imported metal. Most of the metal the company produces will be used in its own works, but it has agreed to continue supplies to other users who require the metal for special purposes. Such sales will be licensed by the Ministry of Supply in accordance with any distribution scheme currently in operation. The British Aluminium Company, Ltd., will sell at prices not exceeding the Ministry of Materials' current prices for imported aluminium.

Coal Output

As we go to press, preliminary figures of coal output for the whole of last year have just been published. In the fifty-two completed weeks to December 27, 1952, the total production of saleable coal was 224,939,200 tons, which was about 2,700,000 tons more than in 1951. That total included 212,830,700 tons from the deep mines and 12,108,500 tons from opencast workings. Total coal production in 1951 was 222,256,500 tons, of which 211,270,700 tons came from the deep mines.

Output in the week prior to the Christmas holiday was 4,603,200 tons, of which 4,422,300 tons came from the deep mines and 180,900 tons from opencast workings. The deep mined production in that week was hindered in the early part of the week by the unofficial strike of winders in the Yorkshire coalfield, the estimated loss through all disputes in the week being put at 190,200 tons. In the week ended December 13th, the number of wage earners on colliery books was 719,700, of whom 298,500 were working at the face. A year earlier the manpower figure was 697,200, of whom 286,300 were face workers. Inland coal consumption in the first fifty weeks of last year totalled 197,575,000 tons, or about 2,300,000 tons less than in the comparable period of 1951. On the other hand, export and bunker deliveries, at 14,553,000 tons, were 3,300,000 tons or so in advance of those made in the corresponding period of 1951. Total distributed stocks of coal on December 13th last were recorded as 17,963,000 tons, compared with 16,908,000 tons on December 15, 1951.

British Trade Mission to Latin America

The Board of Trade has made a preliminary report concerning the activities of a United Kingdom trade mission which in recent months has visited Venezuela, Colombia, the Dominican Republic, Cuba and Mexico. It says that the mission has been given a most favourable and cordial reception.

The members of the mission have pointed out that each of the countries visited has its own special requirements. In Venezuela, for example, a clear picture was obtained of the vast public works developments in hand or projected, coupled with the exploitation of as yet undeveloped natural resources and the growth of minor industries. In Colombia the mission found a major public works programme in progress, as well as plans for the further intensive development of natural resources. In the Dominican Republic there was evident a keen desire to increase purchases from the United Kingdom, and in Cuba the main interest was in the many requirements of the sugar industry and the Government's programme of public works. In Mexico, the mission was impressed by the rate at which industries and natural resources of all kinds are being developed and expanded.

In all these countries, the members of the mission believe, there is a real opportunity for British exports, but they point out that to operate in those markets is expensive and that "competition will be found to be exceptionally keen." At the moment, the U.S.A. predominates, with European nations all making intensive efforts to take a share in the trade. In each of the five countries visited, the mission reports, British small cars have found a market, and as the ambitious road development programmes materialise there will undoubtedly be a growing demand for all kinds of road vehicles. The mission goes on to say that light and heavy engineering industries have a "truly wonderful opening." The first step is that they should be prepared to send out technicians to study and open up the markets. It was immediately evident in all markets, the mission adds, that the lack of British technicians in the field, compared with this country's competitors, is the biggest handicap.

Changes in Wage Rates

According to the *Ministry of Labour Gazette*, changes in wage rates which took effect during November last resulted in an aggregate increase of £986,000 in the weekly full-time wages of about 2,905,000 workpeople, and in a decrease of about £4300 in the weekly wages of 180,000 workpeople. The decreases occurred under sliding scale arrangements based on the index of retail prices and, in the main, affected workers in the iron and steel industry and in iron ore mining and quarrying. Of the total increase of £986,000, about £934,000 resulted from direct negotiations between employers and workpeople; about £23,000 was the result of arrangements made by Joint Industrial Councils and similar bodies; about £18,000 resulted from arbitration awards, and £9000 resulted from Orders made under the Wages Councils Acts.

Among those receiving increases during November were those employed in the engineering and allied industries. There were increases of 7s. 4d. a week for adult male timeworkers and payment-by-result workers, and of 6s. 5d. a week for women workers of eighteen and over. The minimum rates for adult male workers paid on an engineering basis in Government industrial establishments were also increased by 7s. 4d. a week. In the shipbuilding and ship repairing industries, adult male workers received an increase of 7s. 6d. a week, and in Admiralty dockyards the increase was 7s. 4d. a week. Men employed in conciliation grades by British Railways and those in the railway service of London Transport received an increase of 7s. a week; women employed in the place of men receiving the same amount, while those in other grades received an increase of 5s. 6d. a week. Adult male workers in railway workshops received an increase of 7s. a week. Among others receiving wage increases in November were those employed in electrical installation work, electric cable making, the light castings industry, and in heating and ventilating engineering.

The new wage rates taking effect in November brought the net amount of increase in weekly wages in the first eleven months of last year to £4,282,000, the number of workers participating being 11,085,500. In the comparable period of 1951 there was a net increase of £5,977,000 in the weekly full-time wages of 11,689,000 workpeople. Of the total amount of last year's wage increases, a sum aggregating £1,099,400 a week went to 2,761,000 people employed in the industries classified as "engineering, shipbuilding and electrical goods" and "vehicles." At the end of November last the index of rates of wages (June, 1947=100) stood at 133 for all workers and had thus advanced 6 points since December, 1951.

Notes and Memoranda

Rail and Road

PRESENTATION TO LIEUT.-COLONEL EVERARD.—Upon relinquishing his appointment as chief officer, engineering (maintenance), Railway Executive, to become general manager of Rhodesia Railways, Lieut.-Colonel H. B. Everard was recently presented with a piece of plate by the members of the Railway Executive civil engineers' committee. Mr. J. C. L. Train, chairman of the committee, presided at the ceremony, and the presentation was made by Mr. Ian R. Frazer, civil engineer, Scottish Region. Lieut.-Colonel Everard began his railway engineering career on the Midland in 1922, and has been chief officer, engineering (maintenance), with the Railway Executive for the past four years. He is the president of the Permanent Way Institution.

TRAFFIC CONTROL ON RHODESIA RAILWAYS.—An order has been placed with the Siemens and General Electric Railway Signal Company, Ltd., by the Rhodesia Railways for the supply of a further section of centralised traffic control extending from Gwelo to Gatooma, a distance of 89 miles, forming the middle stretch of the important rail link of 296 miles between Bulawayo and Salisbury. Equipment has already been supplied by the same company for the first section of this link between Bulawayo and Gwelo, and the system is in traffic operation as far as Somabula. The new section includes fourteen crossing sidings, all of which will be controlled from a machine located at Gwelo. The installation involves the provision of a C.T.C. control machine with its associated field stations, 89 miles of track circuiting, with crossing loops, as well as approximately 200 running and subsidiary signals. In addition, there will be many hundreds of signalling relays for interlocking and control purposes.

Air and Water

THE HANDLEY PAGE "HP 80" BOMBER.—Another bomber of advanced design was released from the secret list on Saturday last. It is made by Handley Page, Ltd., and in respect of speed, height, range and bomb load the company claims that the aircraft is superior to all other craft. Its superior performance at great heights is credited to certain wing characteristics, amongst them being the wing profile itself, which is crescent shaped. This plan form derives from the use of three distinct angles of sweep-back, decreasing from the wing root. Four Armstrong Siddeley "Sapphire" turbo-jet engines are fitted.

ASLIB AERONAUTICAL GROUP CONFERENCE.—The Aslib Aeronautical Group of technical librarians and information officers serving the aircraft industry will hold their second annual conference at the College of Aeronautics, Cranfield, from Friday, March 27th, till Monday, March 30, 1953. Technicians and librarians from Europe, America and the Dominions are to contribute papers and social events will be arranged. All who are interested in promoting the efficient exchange of aeronautical information will be welcome at the conference, whether members of Aslib or not. Further particulars will be announced shortly by the Group Secretary, Mr. C. W. Cleverdon, College of Aeronautics, Cranfield, Bletchley, Buckinghamshire.

LLOYD'S WRECK RETURNS.—The returns of merchant ships totally lost and broken up issued by Lloyd's Register of Shipping for the quarter ended June 30, 1952, gives the world total of steamships and motorships lost consequent upon casualty as twenty-seven ships of 46,737 tons gross. Of this total two ships of 746 tons were owned in Great Britain and Northern Ireland and two ships of 519 tons by the other Commonwealth countries. Of the steamships and motorships lost, not consequent upon casualty, forty ships of 102,781 tons belonged to Great Britain and Northern Ireland and the corresponding figure for the other Commonwealth countries was three ships of 1989 tons, while the world total amounted to ninety-one ships, representing 172,199 tons gross.

PORT MODERNISATION IN INDIA.—The Government of India's scheme for the modernisation and development of India's major ports and the building of Kandla Port was outlined recently by the Transport Minister. According to *Indian Trade and Industry*, the scheme is estimated to cost £30,000,000, of which £22,500,000 will be spent on expanding the five existing major ports. The balance will be spent on Kandla Port and the creation of port facilities for the oil refineries and alternative facilities for existing establishments on Butcher Island. Kandla Port will provide a natural outlet for the traffic previously catered for by Karachi. As such, it will look after the needs of the vast hinterland of Punjab, Rajasthan, and Central India more economically than does Bombay. Economy will be achieved by the reduction of about 200 miles in transport. Improvements to Calcutta Port are expected to cost more than £8,250,000, to Bombay £7,500,000, and to Madras about £3,000,000. The plan for Cochin provides for construction of new berths for general cargo. Developments at Butcher Island include the construction of a pier.

SURFACE WATER SUPPLY OF CANADA.—The Canadian Department of Resources and Development has now published Volume 103 of the *Water Resources Papers, Surface Water Supply of Canada*. This report contains run-off data for the climatic years 1947–48 and 1948–49 for the St. Lawrence and Southern Hudson Bay Drainage, which covers the greater part of the Provinces of Ontario and Quebec. The data presented are the results for the period October 1, 1947, to September 30, 1949, of the hydrometric investigations which were carried out in the two provinces, in large part by the Water Resources Division, although operations were facilitated by co-operation received from the Hydro-Electric Power Commission of Ontario, the Quebec Hydro-Electric Commission, and a number of private agencies. The report, which is bilingual, in that the English and French versions are combined in the one volume, includes a short description of the organisation and scope of operations, an explanation of the method of tabulation, and 407 pages of stream-flow and water-level data for a number of rivers, streams and lakes in Ontario and Quebec. The appendix contains a reference list of hydrometric records for this drainage division, a list of available *Water Resources Papers*, and an index to the current issue. The report may be obtained from the Water Resources Division, Department of Resources and Development, Ottawa, 4, Ontario.

Miscellanea

BUYING PRICE FOR TUNGSTEN ORE.—The Ministry of Materials announces that from December 30, 1952, its buying prices for tungsten ores of standard 65 per cent grade and ordinary quality are: Wolframite, 370s. and Scheelite, 360s., per long ton unit c.i.f. United Kingdom port.

PETROLEUM EQUIPMENT.—The Council of British Manufacturers of Petroleum Equipment has stated that in the third quarter of last year the orders received from British oil companies were worth £25 million which brought the total for the first nine months to £70 million. It is expected that the orders placed during the last three months of 1952 will bring the total for the year to over £90 million.

METAL CONTROLS.—The Minister of Supply has made an Order removing from price control unwrought brass and scrap of gilding metal, cupro-nickel and brass. This has been made possible by the improved supplies of these metals. Secondary copper and copper scrap remain subject to price control for the time being. The Order is entitled the Copper, Zinc, &c., Prices (No. 6) Order, 1952. It came into operation on December 31st.

ANGLO-SWEDISH TRADE TALKS.—The Board of Trade has stated that trade negotiations in regard to the year 1953 with Sweden have now been successfully concluded. Increased quantities of Swedish iron ore are to be available to the United Kingdom in the present year and import facilities for motor-cars will be higher than in 1952. Coal and coke exports to Sweden are likely to be higher and steel exports will be slightly increased.

PERSIAN GULF OIL CONCESSIONS.—It is announced that exploration operations in the underwater oil concession, covered by the agreement concluded between the Sheikh of Qatar and "Shell" Overseas Exploration Company, Ltd., will be started immediately. The area concerned extends into the Persian Gulf outside territorial waters, the land and territorial waters of Qatar are already held under concession and the oil produced is shipped from the Port of Umm Said.

THE LATE MR. J. S. DREWRY.—We have learned with regret of the death of Mr. James Sidney Drewry, M.I.Mech.E., which occurred at Letchworth, Herts, on December 14th last. Mr. Drewry, who was seventy, began his career in his family's cycle business at Herne Hill, and subsequently joined the De Dion Company as a junior engineer. Later, he did a great deal of work in the design and production of road and rail cars, and for several years was joint managing director of Shelvoke and Drewry, Ltd., from which office he retired in 1936.

WORKS MANAGERS' CONFERENCE.—The Industrial Welfare Society is arranging a week-end conference for works managers, from Friday next, January 9th, to Monday morning, January 12th, at the Hydro Hotel, Llandudno. The main theme of this conference is "Human Relations and Productivity," and at the various sessions, under the chairmanship of Mr. John Marsh, there is to be opportunity for detailed discussion on the problems facing management at the present time, and on the practical solution of those problems.

HYDROCARBON OIL DUTIES.—The Treasury has made the Hydrocarbon Oil Duties (Drawback) (No. 3) Order, 1952, which provides for the allowance of drawback of customs or excise duty paid in respect of hydrocarbon oils used in the manufacture or preparation of gaskets, joints, packing sleeves, valve rings and valve discs made wholly or mainly of rubber and asbestos fibre sheeting; leathercloth, table oil baize and similar material; gutta percha or balata of a kind suitable for use in the manufacture of golf balls; bone glue and solid woven belting. The drawback applies in respect of articles exported, or shipped, or deposited in warehouse for use as ships' stores, on or after December 20, 1952.

WEIGHTS AND MEASURES LEGISLATION.—The President of the Board of Trade recently announced in the House of Commons that he was arranging consultations about the recommendations of the Committee on Weights and Measures Legislation with the trading, local authority and other interests concerned. He said that on account of the variety of the recommendations and the extensive nature of the consultations, legislation would not be introduced for some time. Consultations are now beginning and the Board would be glad to receive comments on any of the committee's recommendations from interested parties. It would be of great assistance if persons or organisations intending to submit comments would give the Board notice of their intention to do so as soon as possible, indicating the recommendations on which they propose to comment. All correspondence should be addressed to the Controller, Standards Department, Board of Trade, 26, Chapter Street, London, S.W.1.

ENGINEERING AND ALLIED EMPLOYERS LONDON AND DISTRICT ASSOCIATION.—At a reception held at 23, Essex Street, Strand, London, W.C.2, on Tuesday, December 30th, new offices into which the Engineering and Allied Employers London and District Association has just moved were inaugurated. In welcoming guests to these new offices the President, Mr. Pheazey, of Standard Telephones and Cables, Ltd., remarked upon the historic nature of the site. The building is alongside Essex Stairs, originally steps leading down, in the reign of Queen Elizabeth I, from the house of the Earl of Essex to the Temple Gardens by the riverside. In connection with the work of the Association he remarked that there was a relatively small number of people in this country who acted as a stabilising ballast to the remainder. They were to be found amongst industrialists, trades union leaders and others, and they were always labouring for harmony and good relations in industry and interested in helping along negotiations. The President-Elect, Mr. Broadbent, of the Fairey Aviation Company, Ltd., also welcomed the guests.

MR. JOHN G. ROBB.—Mr. John Glover Robb, M.I.E.E., F.Inst.P., who died on December 16th, aged sixty-two, at his home in Braithwaite, Cumberland, was formerly deputy engineer-in-chief of Marconi's Wireless Telegraph Company, Ltd., and chief of the company's research laboratories. He joined the company in July, 1909, and served for two years in the Argentine. In 1913 he was appointed engineer-in-charge of the Transatlantic station at Louisburg, Nova Scotia. During his commissioned service in the R.N.V.R. from 1915 to 1919, he was concerned with the erection and running of Admiralty direction-finding stations. After the war he did research work with Captain H. J. Round, Mr. C. S. Franklin and others, mainly on short wave beam broadcasting and telephony. In 1934 he was appointed development manager to the company and in 1939, he was made technical manager and director of research. He became deputy engineer-in-chief in 1947 and a year later was created head of a new engineering division designed to exchange technical knowledge between Marconi companies at home and overseas. Mr. Robb retired in 1950.

Personal and Business

MR. PHILIP RACKHAM has been appointed home sales manager, and Mr. P. J. Arrow, south-eastern regional manager, of A.C.V. Sales, Ltd.

MR. L. E. MATHER, C.B.E., M.I.Mech.E., and Mr. John Ryan, C.B.E., have been appointed members of the Royal Commission on Awards to Inventors.

THE SPERRY GYROSCOPE COMPANY, Ltd., Great West Road, Brentford, states that Wing Commander J. C. G. Bell, sales manager, has been elected a director of the company.

MR. S. J. AYRES, assistant mechanical engineer of the National Coal Board, has been appointed H.M. Deputy Principal Inspector of Mechanical Engineering in Mines and Quarries, Ministry of Fuel and Power.

MR. J. ALLAN PERHAM has been appointed managing director of Atlas Diesel Company, Ltd., Beresford Avenue, Wembley, in succession to Mr. E. B. F. Johnson, who has been appointed managing director of Swedish Atlas Compressed Air, Ltd.

MR. H. R. WATLING has retired from the office of director of the British Cycle and Motor Cycle Manufacturers and Traders Union, but will continue to serve the Union as a consultant. Mr. H. M. Palin has succeeded to the office of director.

POWER UNITS AND EQUIPMENT, Standbrook House, 2–5, Old Bond Street, London, W.1, has been appointed sole importer and distributor in the United Kingdom of "Wisconsin" engines and parts, and has taken over from R. A. Lister and Co., Ltd., all "Wisconsin" stores and parts.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., states that Mr. F. C. Barford, M.I.E.E., manager of its Newcastle upon Tyne district office, has been appointed manager of the Manchester district office, in succession to Mr. A. B. Race, who has retired. Mr. S. J. Clarke succeeds Mr. Barford as manager at Newcastle upon Tyne.

WALKER BROTHERS (WIGAN), Ltd., announces the retirement of Mr. S. B. Haslam, its South Wales representative. For the present all inquiries from the area should be sent to the head office at Pagefield Iron Works, Wigan. The company has also announced the closing of its branch office at 90, Pilgrim Street, Newcastle upon Tyne.

KENT-NORLANTIC, Ltd., Horner Avenue, Toronto, 14, has been formed to take over from its parent company, George Kent, Ltd., the marketing in Canada of Kent industrial instruments and "Norlantic" water and steam meters. Mr. Kenneth R. Wells is the president of the new company, the other directors being Mr. W. G. C. Howland and Mr. Rodney G. Kent.

THE SOCIETY OF MOTOR MANUFACTURERS AND TRADERS, Ltd., announces the appointment of Mr. R. W. Walker as its South American representative in place of Colonel K. R. Stirling-Wyllie, who has been obliged, for health reasons, to return to this country. Mr. Walker's address is Avenida Cordoba 645, 6°, Buenos Aires. The S.M.M.T. also announces the appointment of Mr. A. E. Grant-Crofton as its European representative.

British Patent Specifications

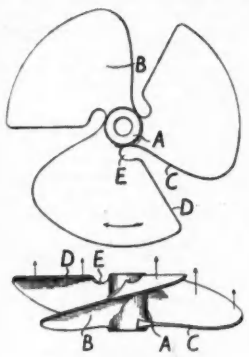
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 2s. 8d. each.

MARINE ENGINEERING

683,012. March 6, 1951.—SCREW PROPELLERS, Oscar Abraham Wirkkala, 342, Eighteenth Avenue, Seattle, Washington, U.S.A.

Objects of the invention are to increase efficiency by providing a propeller design that will save fuel, reduce vibration and noise, and substantially eliminate vacuum pockets at the propeller. In the drawing *A* is the hub of the propeller having blades *B*. Each blade extends through an arc of approximately 90 deg. from forward to trailing edge, leaving adequate clearance between its trailing edge and the forward edge of the following blade. Each blade has a leading



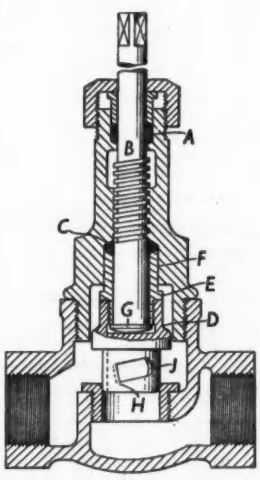
No. 683,012

edge *C* curved outwards on an arc from the hub and in a plane that is substantially perpendicular to one end portion of the hub. The trailing edge of the blade *D* is straight and extends radially from the hub in a perpendicular plane to the hub axis at the rear end. The trailing edge terminates inwards to form the recesses *E*. The blade has uniform pitch. Because of its form, substantially all slip in operation is eliminated and all propelling forces are directed straight back of the propeller as indicated by the arrows in the lower view, giving increased efficiency. By reason of the blades having their trailing edges *D* radially directed in a plane perpendicular to the axis of rotation and other elements of design, undesirable noise and turbulence in the propeller's wake is greatly reduced.—*November* 19, 1952.

VALVES

682,851. January 16, 1950.—LIFT VALVES, Alexander Middleton, 19, Guildhall Chambers, 13, Sandhill, Newcastle upon Tyne, 1.

Referring to the drawing, the body of the valve is of standard pattern and is fitted with a screw-in valve seat and a screw-in cover. The customary



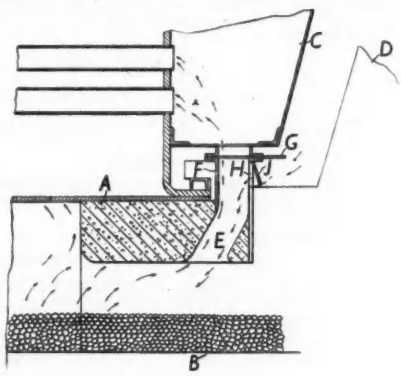
No. 682,851

packed stuffing-box and gland for the outer end of the valve spindle are provided in the head of the cover and secured by a nut. In addition to the stuffing-box *A* there is provided for the inner end of the valve spindle *B* a stuffing-box *C* in the cover, and the valve member *D* is fitted with a screw-in part *E* having a tubular extension *F* about the spindle which provides a gland to compress the packing in the stuffing-box. The number of turns of packing used in the stuffing-box *C* is regulated to allow the valve member to be operated to the maximum lift required; the threaded valve spindle *B* has a projecting end *G* which engages beneath the part *E* in the valve member *D*, so that rotation of the spindle raises and lowers this member. The valve seat is chamfered about its inner edge as shown, and the hollow stem *H* of the valve member is provided with three apertures *J* which are oblique to the axis of the stem and are disposed 120 deg. apart. It will be seen that the provision of the stuffing-box *C* and gland *F* not only prevents leakage of steam but allows the stuffing-box *A* at the outer end of the spindle to be repacked whilst the valve is open to steam pressure. The inclined apertures *J* in the steam of the valve member co-operate with the chamfered inner edge of the valve seat to direct the flow of steam and protect the faces of the valve member and valve seat from damage by wire-drawn steam. The invention is applicable to lift valves generally, such as are used for controlling the supply of steam, gas, oil or other fluids where fine regulation is required.—*November* 19, 1952.

FURNACES

683,537. October 19, 1949.—BOILER COMBUSTION ARRANGEMENTS, Bennis Combustion, Ltd., Little Hulton, Bolton, Lancaster, and Robert Burton Page, and Edward Smith, both of the company's address.

The object of the invention is to enable hot gases to be drawn over the fire in the front region of the furnace, to aid the combustion in a simple and efficient manner, and to allow, alternatively, the induction of secondary air using the same means.



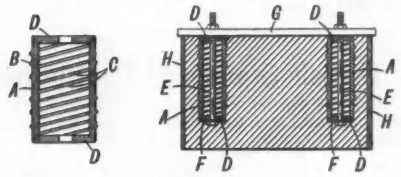
No. 683,537

In the form illustrated in the drawing a boiler of the shell type has an ignition arch *A* of refractory material above the front *B* of the fire grate. Immediately above the arch is the smokebox *C*, whilst in front of the arch and smokebox is a stoker hopper *D*. A passage *E* is provided through the ignition arch and a duct *F* connects it to an inlet to the smokebox. Damper means *G* are provided near the smokebox inlet end of the duct. An auxiliary inlet *H* into the duct is also controlled by the damper *J*. In operating the fire grate, the pressure in the smokebox is normally less than that existing in the combustion space above the grate, and due to this, hot gases are continually drawn through the passage *E* in the arch and into the box. Due to the intimate contact of these hot gases with the fresh fuel lying on the forward region of the grate, the refractory arch is heated and the combustion of the fuel is considerably improved. The passage in the arch may be used for the induction of secondary air. In this case the damper controlling the smokebox inlet is closed and that controlling the auxiliary inlet to the duct is opened and air supplied by natural or forced draught.—*December* 3, 1952.

STRUCTURAL ENGINEERING

683,700. November 29, 1949.—HOLDING-DOWN BOLT BOXES, Tony Lees Johnson, Eversley Garth, Sherburn-in-Elmet, Leeds, and Jack Hamilton Abrams, Folley House, Church Street, Ilchester, Somerset.

As shown in the drawing, the bolt box comprises a precast concrete tube *A* which is formed with spaced annular ridges *B* on its outer surface and spiral grooves *C* on its inner surface. The ridges form keys for the box with the concrete surrounding whilst the spiral grooves ensure a good key with the final grout filling. At the upper end of the bolt box is fitted a locator *D* having a central hole for the passage of the machinery or plant holding bolt *E*. The locator maintains the bolt accurately centred within the box and ensures that the grouting space within the bolt box is kept clear during the period prior to fixing. Similarly formed bottom locators *D* at the bottom of the boxes are held in place by base plates *F* on the holding bolts *E*. The fixing is as follows. Precast concrete boxes of sufficient diameter to give the working clearance required are placed on the bolt to rest upon the bottom locator which is supported on the base plate. The bolt or bolts and their boxes may be suspended by the nuts from a template *G*, which is fixed across the shuttering *H* and positions the



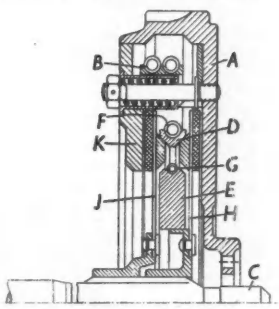
No. 683,700

assembly. The concrete is then poured in. When ready for fixing the steelwork, machinery or plant, the top locator cap is removed and stored for future use and the grout filling is poured into the bolt box. Thus the bolt boxes remaining *in situ* become an integral part of the concrete foundation in which the holding bolts are embedded, and the boxes provide the main resistance to withdrawal of the bolt once the concrete has set.—*December* 3, 1952.

ROAD TRANSPORT

683,570. September 14, 1950.—CENTRIFUGAL CLUTCH FOR STARTING A MOTOR VEHICLE, Fritz Kreis, 37, Mainaustrasse, Wurzburg, Germany, and Societa Italiana Brevetti Automobilistici, 19, Via Domodossola, Milan, Italy.

In the drawing the driving clutch half is shown at *A* and the centrifugal weights moved by it at *B*. The centrifugal weights moved by the driven shaft *C* consist of an external part *D* and an internal part *E* rotatable together, but relatively movable radially, these parts being held inwards (until a certain revolutional speed is reached) by means of tie springs *F* and



No. 683,570

G respectively. The centrifugal weights *D*, under the control of the tie spring *F*, tend always to maintain the coupling discs *H* and *J* against the respective engaging discs *A* and *K*; centrifugal weights *E* have a similar effect when the driven shaft *C* is already rotating and the weights are already moved outwardly from their rest position to a certain extent. Disengagement of the clutch due to outward swinging of the centrifugal weights of the driven coupling half, within a certain space of time, is not therefore possible. On the contrary, the driven shaft and, hence, the vehicle, when starting on a level surface, always receives a uniform acceleration.—*December* 3, 1952.

MISCELLANEOUS

683,221. March 1, 1950.—THERMAL INSULATION COVERINGS, Fibreglass, Ltd., Ravenhead, St. Helens, Lancaster (*Inventor: Andrew de Dani*).

The invention relates to thermal insulation coverings, and particularly pipe coverings, of the kind required to withstand high temperatures, such as 400 deg. Cent. and over, made at least in part from fibrous materials. A covering in accordance with the invention comprises an inner layer of relatively high density, and an outer layer of relatively low density, the inner layer being made from bonded mineral wool or exfoliated vermiculite, and the outer layer being made from bonded glass fibres. A mineral wool or exfoliated vermiculite, mixed with a temperature-resistant binder of sodium silicate, a quick-setting cement, or other suitable binding substance, is placed in thin layers around a mandrel to form a mass of sufficient thickness and density to ensure the desired temperature drop across the mass. Around this mass is wrapped an outer non-brittle mass of any convenient thickness made from glass fibres bonded with starch. The thickness of the first mass is such that the heat transmitted can have no deleterious effect on the bonding of the outer mass. Subse-

quently, the material thus formed is cut into sections to enable it to be applied to a pipe. Alternatively, a mass of bonded glass fibres is wound on a mandrel of larger diameter than the one used in the foregoing example, and, after drying, the mass is slit to form two or more parts. To the inner side of each such part is then applied the other material by spraying or otherwise. Whilst the latter is still plastic, the parts are placed on a mandrel of the diameter of the pipe to be covered and allowed to set.—*November 26, 1952.*

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24, Victoria Street, London, S.W.1.

GLOSSARY OF TERMS (WITH SYMBOLS) RELATING TO THE WELDING AND CUTTING OF METALS

No. 499 : 1952. The considerable increase in the application of welding which resulted from the war and the many new techniques developed since the 1939 edition of B.S. 499 have necessitated a much more comprehensive treatment of the subject than was given previously. In view of the magnitude of the subject it was decided to divide the Glossary into a number of sections dealing respectively with : terms common to most types of welding ; welding with pressure ; fusion welding (welding without pressure) ; brazing and bronze welding ; testing ; weld imperfections ; scheme of symbols, and cutting.

The largest sections of the Glossary are naturally those relating to welding with pressure and to fusion welding. These, like the other sections, deal fully with the terminology applicable to the techniques and equipment. A separate section on testing contains many terms which have an application to diverse welding practices and, by giving greater prominence to preferred terms, it encourages general use. The scheme of symbols for welding—which has already been published separately—represents a considerable advance on that given in the appendix to the 1939 edition. As previously announced, this scheme differs radically from former procedure in order to comply with the general move towards achieving greater co-ordination between American, Canadian and British practice which originated at the Ottawa Conference in 1945.

The standard also includes the publication known previously as B.S. 449, Part 2, which deals with those terms relating to imperfections in welds which are appropriate for radiographic examination.

The specification is well illustrated with sketches and line drawings. An interesting item is a chart showing the derivation of the various welding and cutting processes. The publication is completed by means of a fully cross-referenced index of all terms dealt with. Price 21s.

Calendars and Diaries

We acknowledge the receipt of calendars and/or diaries for 1953 from the undermentioned firms :—

Swedish Lloyd, Gothenburg.
Ruston-Bucyrus, Ltd., Lincoln.
Holman Bros., Ltd., Camborne.
Brook Motors, Ltd., Huddersfield.
Aveling Barford, Ltd., Grantham.
Ruston and Hornsby, Ltd., Lincoln.
A. V. Roe and Co., Ltd., Manchester.
Butters Bros. and Co., Ltd., Glasgow.
High Duty Alloys, Ltd., Slough, Bucks.
Aero Research, Ltd., Duxford, Cambridge.
Goodwin, Barsby and Co., Ltd., Leicester.
G. and J. Weir, Ltd., Cathcart, Glasgow, S.4.
James N. Connell, Ltd., Coatbridge, Scotland.
D.P. Battery Company, Ltd., Bakewell, Derbyshire.
North British Locomotive Company, Ltd., Glasgow.
Crossley Brothers, Ltd., Openshaw, Manchester, 11.
The British Oxygen Company, Ltd., London, S.W.1.
Gear Grinding Company, Ltd., Shirley, Birmingham.
A.C.V. Sales, Ltd., 49, Berkeley Square, London, W.1.
The Gas Council, 1, Grosvenor Place, London, S.W.1.
Tube Investments, Ltd., Aston Manor, Birmingham, 6.
Bakelite, Ltd., 18, Grosvenor Gardens, London, S.W.1.
Northern Aluminium Company, Ltd., Banbury, Oxfordshire.
Richard Sutcliffe, Ltd., Universal Works, Horbury, Wakefield.
Russell, Newbery and Co., Ltd., Essex Works, Dagenham, Essex.
Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.
Edward Wood and Co., Ltd., 68, Victoria Street, London, S.W.1.
C. A. Parsons and Co., Ltd., Heaton Works, Newcastle upon Tyne, 6.
Northern Manufacturing Company, Ltd., Albion Works, Gainsborough.
Philip Henderson and Co., Ltd., 1, Wine Office Court, London, E.C.4.
Vickers-Armstrongs, Ltd., Vickers House, Broadway, London, S.W.1.
Association of Building Technicians, 5, Ashley Place, London, S.W.1.
Fischer Bearings Company, Ltd., Upper Villiers Street, Wolverhampton.
George Wailes and Co., Ltd., 382-388, Euston Road, London, N.W.1.
Davidson and Co., Ltd., Sirocco Engineering Works, Belfast, N. Ireland.
Stewarts and Lloyds, Ltd., Brook House, Upper Brook Street, London, W.1.
Spottiswoode, Ballantyne and Co., Ltd., 1, New Street Square, London, E.C.4.
John I. Thornycroft and Co., Ltd., Thornycroft House, Smith Square, London, S.W.1.
J. E. Raistrick, Ltd., Reliance Works, Park Royal Road, North Acton, London, N.W.10.
Chloride Electrical Storage Company, Ltd., Exide Works, Clifton Junction, near Manchester.
The Telegraph Construction and Maintenance Company, 22, Old Broad Street, London, E.C.2.
Laurence, Scott and Electromotors, Ltd., 431, Grand Buildings, Trafalgar Square, London, W.C.2.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on or before the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

BRITISH INSTITUTION OF RADIO ENGINEERS

Mon., Jan. 5th.—London Section : School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, "The Modern Single-Layer Selenium Photocell," G. A. Veszi, 6.30 p.m.
Thurs., Jan. 8th.—Scottish Section : Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, Film Evening, 7 p.m.

CLEVELAND INSTITUTION OF ENGINEERS

Mon., Jan. 5th.—Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, "Operation of Blast-Furnaces at Clyde Ironworks at High Top Pressure," R. P. Towndrow, 6.30 p.m.

COMMUNICATION TRAINING CENTRE

Mon., Jan. 5th.—University College, Gower Street, London, W.C.1, day conference dealing with "Language in Presentation," "Logic in Presentation," and "The Psychology of Presentation," Reginald O. Kapp, B. C. Brookes and A. C. Leyton, 9.30 a.m.–4.30 p.m.

ENGINEERS' GUILD

Tuesday, Jan. 6th.—W. Midlands Branch : Imperial Hotel, Temple Street, Birmingham, "Presentation of Technical Information," R. O. Kapp, 6.30 p.m.

HULL CHEMICAL AND ENGINEERING SOCIETY

Thurs., Jan. 8th.—Church Institute, Albion Street, Hull, "Science and Domestic Heating," R. A. Mott, 7.30 p.m.
Tues., Jan. 13th.—Church Institute, Albion Street, Hull, Presidential Address, "Oil Additives," G. E. Gray, 7.30 p.m.

ILLUMINATING ENGINEERING SOCIETY

To-day, Jan. 2nd.—Bath and Bristol Centre : S.W. Electricity Board Lecture Theatre, Colston Avenue, Bristol, Discussion on Home Lighting, 5.30 p.m.——Birmingham Centre : Main Hall, College of Technology, Suffolk Street, Birmingham, Exhibition of New Lighting Equipment, 6 p.m.
Wed., Jan. 7th.—London Centre : Visit to Croydon "B" Power Station.——Edinburgh Centre : Welfare Club Hall, Lighting and Cleansing Department, 357, High Street, Edinburgh, "Colour as a Framework to Industry," Mrs. D. M. Buckland, 7 p.m.——Newcastle Centre : Minor Durrant Hall, Oxford Street, Newcastle upon Tyne, "Museum and Art Gallery Lighting," W. E. Rawson-Bottom, 6.15 p.m.
Thurs., Jan. 8th.—Glasgow Centre : Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "Colour as a Framework to Industry," Mrs. D. M. Buckland, 6.30 p.m.——Manchester Centre : Demonstration Theatre, N.W. Electricity Board, Town Hall Extension, Manchester, "Lighting in the Food Industry," R. L. C. Tate, 6 p.m.——Nottingham Centre : Demonstration Theatre, E. Midlands Electricity Board, Smithy Row, Nottingham, Student Members' Viewpoints, J. Eddyshaw, W. Mosedale, N. S. Rutherford and J. R. Wakefield, 6 p.m.

INCORPORATED PLANT ENGINEERS

To-day, Jan. 2nd.—Birmingham Branch : Imperial Hotel, Temple Street, Birmingham, "Metal Spraying for Protection," W. E. Ballard : "The Reclamation of Worn Parts by Metal Spraying," R. Wallwork, 7.30 p.m.
Tues., Jan. 6th.—London Branch : Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2, Discussion on the National Fuel Policy, 7 p.m.——S. Wales Branch : S. Wales Institute of Engineers, Park Place, Cardiff, "A Plant Engineer Tours America," G. E. Halter, 7.15 p.m.
Wed., Jan. 7th.—Southampton Branch : Polygon Hotel, Southampton, "Metallising in Relation to Plant Maintenance," J. Porter, 7.30 p.m.
Thurs. Jan. 8th.—Newcastle upon Tyne Branch : Roadway House Oxford Street, Newcastle upon Tyne, "Preventive Maintenance," T. C. Robinson, 7.30 p.m.

INSTITUTE OF ECONOMIC ENGINEERING

Fri. Jan. 9th.—Cowdray Hall, Henrietta Place, Cavendish Square, London, W.1, "Work Study as a Means of Improving Industrial Efficiency," R. M. Currie, 7 p.m.

INSTITUTE OF FUEL

Tues., Jan. 6th.—Scottish Section : Royal Technical College, Glasgow, "The Ridley Report and After," Gerald Nabarro, 7 p.m.

INSTITUTE OF INDUSTRIAL SUPERVISORS

Thurs., Jan. 8th.—London Central Section : Polytechnic, Regent Street, W.1, Annual General Meeting and Industrial Film Show, 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS

Tues., Jan. 13th.—85, Minories, London, E.C.3, "Some Operating Experiences with Two-Stroke Cycle Engines on Boiler Oil and the Development of Fuel Injection Equipment," A. G. Arnold, 5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Tues., Jan. 6th.—Eastern Centre : Mess Room, Eastern Counties Omnibus Company Norwich "Electrical Equipment as Applied to the Modern Heavy Commercial Vehicle," W. A. Bevis, 7 p.m.
Wed., Jan. 7th.—E. Midland Centre : Mechanics Institute, Nottingham, "The Application of Synthetic Resin Adhesives in the Road Transport Industry," T. Maxwell-Hudson, 7.30 p.m.
Thurs., Jan. 8th.—Western Centre : Grand Hotel, Bristol, "Electrical Equipment as Applied to the Modern Heavy Commercial Vehicle," W. A. Bevis, 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS

Tues., Jan. 6th.—Maritime Meeting : Great George Street, Westminster, London, S.W.1, "The Reconstruction of Greenwell's No. 1 Dry Dock and Ancillary Works at Sunderland," Harry Ridehalgh, 5.30 p.m.
Thurs., Jan. 8th.—Midlands Association : James Watt Memorial Institute, Great Charles Street, Birmingham, "Prestressed Concrete in Civil Engineering Works," A. J. Harris, 6 p.m.——N.W. Association : Engineers' Club, Albert Square, Manchester, "The Management of a Railway District Engineer's Office and Some Reference to Permanent Way Design," A. L. Owen, 6.30 p.m.
Tues., Jan. 13th.—Public Health Meeting : Great George Street, Westminster, London, S.W.1, "The Storage, Collection and Disposal of Refuse," J. C. Dawes, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Jan. 5th.—S. Midland Centre : James Watt Memorial Institute, Great Charles Street, Birmingham, "Post-Graduate Activities in Electrical Engineering," W. J. Gibbs, D. Edmundson, R. G. A. Dimmick, and G. S. C. Lucas, 6 p.m.
Tues., Jan. 6th.—Measurements and Radio Sections : Savoy Place, London, W.C.2, "An Improved Scanning Electron Microscope for Opaque Specimens," D. McMullan, 5.30 p.m.——N. Midland Centre : British Electricity Authority, 1, Whitehall Road, Leeds, 1, "Electronic Telephone Exchanges," T. K. Flowers, 6.30 p.m.
Wed., Jan. 7th.—Tees-side Sub-Centre : Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, "Domestic Electrical Installations—Some Safety Aspects," H. W. Swann, 6.30 p.m.——Southern Centre : Technical College, Brighton, "275kV Developments on the British Grid System," D. P. Sayers, J. S. Forrest and F. J. Lane, 6.30 p.m.——N. Scotland Sub-Centre : Caledonian Hotel, Aberdeen, "The Economics of Low-Voltage Supplies to New Housing Estates," F. G. Copland, 7.30 p.m.
Thurs., Jan. 8th.—Ordinary Meeting : Savoy Place, London, W.C.2, "Nuclear Reactors and Applications," Sir John Cockcroft, 4.30 p.m., Symposium of Papers on "Nuclear Reactor Instrumentation," 6 p.m.——N. Scotland Sub-Centre : Royal Hotel, Dundee, "The Economics of Low-Voltage Supplies to New Housing Estates," F. G. Copland, 7 p.m.

INSTITUTION OF ENGINEERING INSPECTION

Tues., Jan. 6th.—Coventry Branch : Technical College, Coventry, "Developments in the Manufacture and Uses of Glass," R. E. Bastick, 7.30 p.m.——S.W. Branch : Grand Hotel, Broad Street, Bristol, "Arc Welding," G. G. Marshall, with Films, 7.30 p.m.
Wed., Jan. 7th.—Birmingham Branch : Chamber of Commerce, New Street, Birmingham, Film Evening, "Output and the Individual" and "The Factory and its Equipment," 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, Jan. 2nd.—General Meeting: Storey's Gate, St. James's Park, London, S.W.1, "Principles and Practice Governing Interchangeability and the Specification of Manufacturing Limits of Size as Influenced by Statistical Considerations," G. C. Adams, 5.30 p.m.
Tues., Jan. 6th.—S.W. Branch : S. Wales Institute of Engineers, Park Place, Cardiff, "Contemporary Methods of Watch Production," R. A. Fell and P. Indermuhle, 6 p.m.——London Graduates' Section : Storey's Gate, St. James's Park, S.W.1, "Industrial Power Transmission Clutches and Couplings," K. J. Freeman, 6.30 p.m.
Fri., Jan. 9th.—Thomas Lowe Gray Lecture : Storey's Gate, St. James's Park, London, S.W.1, "Welding in Marine Engineering," H. N. Pemberton, 5.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

Thurs., Jan. 8th.—London Section : Old Ship Hotel Assembly Rooms, Brighton, Film Evening, "Pattern for Progress," 7 p.m.

INSTITUTION OF SANITARY ENGINEERS

Wed., Jan. 7th.—Visit to the Laboratories and Demonstration Plant of the Cement and Concrete Association, Wexham, Near Slough, 2.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

To-day, Jan. 2nd.—Western Counties Branch : Geology Lecture Theatre, The University, Bristol, "Unusual Design for a Large Constructional Shot," F. R. Bullen, 6 p.m.
Thurs., Jan. 8th.—Joint Meeting with the Reinforced Concrete Association : 11, Upper Belgrave Street, London, S.W.1, "The Construction of Eight Prestressed Concrete Tanks," A. R. Mais, 5.55 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Jan. 2nd.—Townsend House, Greycoat Place, London, S.W.1, Film Evening, "Packaged Power," introduced by H. M. Louch, 7 p.m.
Wed., Jan. 7th.—Midland Section : James Watt Memorial Institute, Great Charles Street, Birmingham, Chairman's Address, "Some Aspects of Modern Material Handling," O. J. B. Orwin, 7 p.m.
Fri., Jan. 9th.—Ordinary Meeting : Townsend House, Greycoat Place, London, W.1, "Automatic Feed Pressworking," C. H. Crawford, 7 p.m.

LIVERPOOL METALLURGICAL SOCIETY

Thurs., Jan. 8th.—Liverpool Engineering Society, The Temple, Dale Street, Liverpool, Open Discussion, 7 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY

Thurs., Jan. 8th.—Technical College, Wigan, "Safety Aspects of Underground Haulage," A. E. Crook, 3.15 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

Fri., Jan. 9th.—Mining Institute, Neville Hall, Newcastle upon Tyne, "Some Further Applications of the Moment Distribution Method of Analysis to the Transverse Strength of Ships," H. J. Adams, 6.15 p.m.

ROYAL INSTITUTION OF CHARTERED SURVEYORS

Mon., Jan. 5th.—Ordinary General Meeting : 12, Great George Street, Westminster, London, S.W.1, "The Schemes of the North of Scotland Hydro-Electric Board," W. M. Robertson and T. Lawrie, 5.30 p.m.